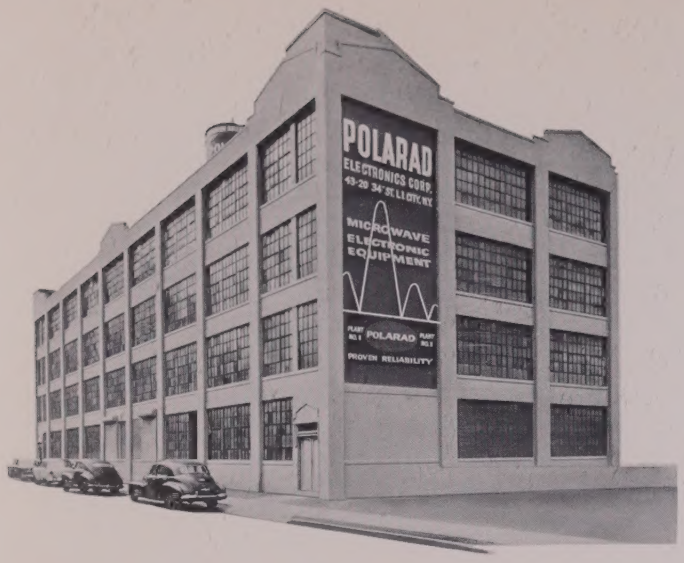
POLARAD

HANDBOOK
OF
OPERATING INSTRUCTIONS

MICROWAVE
FIELD INTENSITY
METER
MODEL FIM-2

VOLUME II

POLARAD ELECTRONICS CORPORATION, 43-20 34th STREET, LONG ISLAND CITY 1, N.Y.



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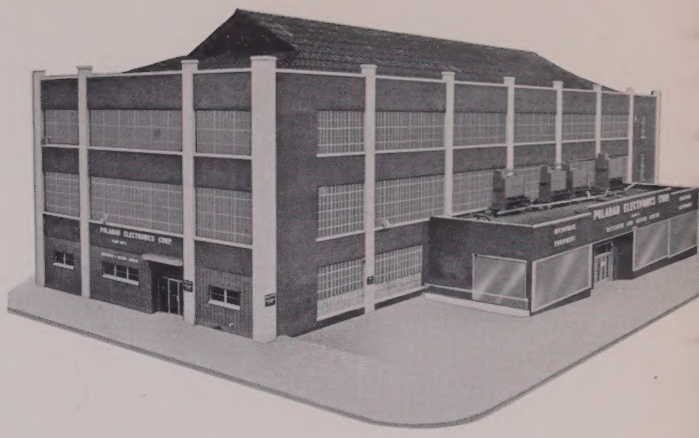

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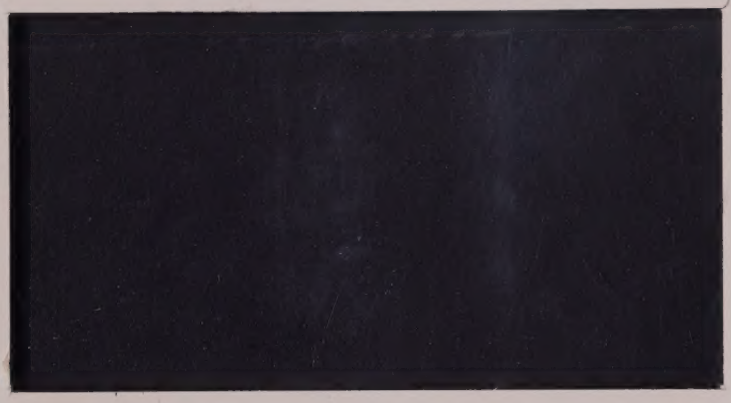

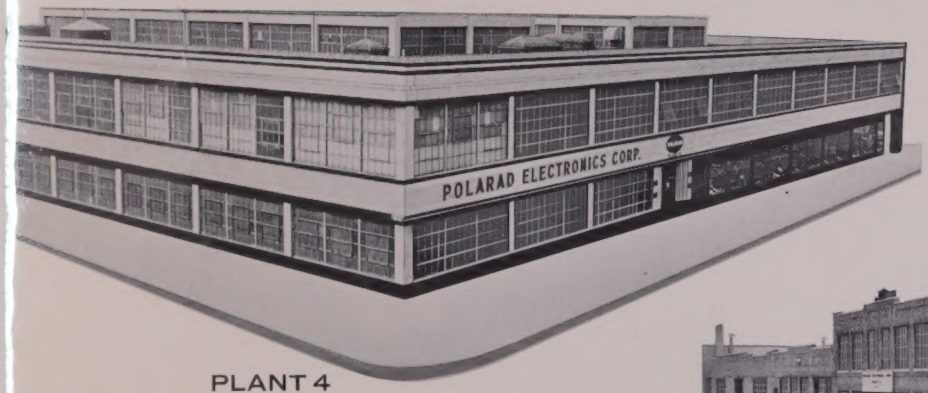

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POLARAD

INSTRUCTION MANUAL

MICROWAVE FIELD INTENSITY METER MODEL FIM-2

VOLUME II

SERIAL NOS. 250 AND UP

POLARAD ELECTRONICS CORPORATION • 43-20 34th St., Long Island City 1, N. Y.

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WARNING:

EXPOSURE TO RADIATION FIELDS GREATER THAN 10 MILLIWATTS PER SQUARE CENTIMETER IS DANGEROUS AND CAN BE FATAL TO HUMAN LIFE.

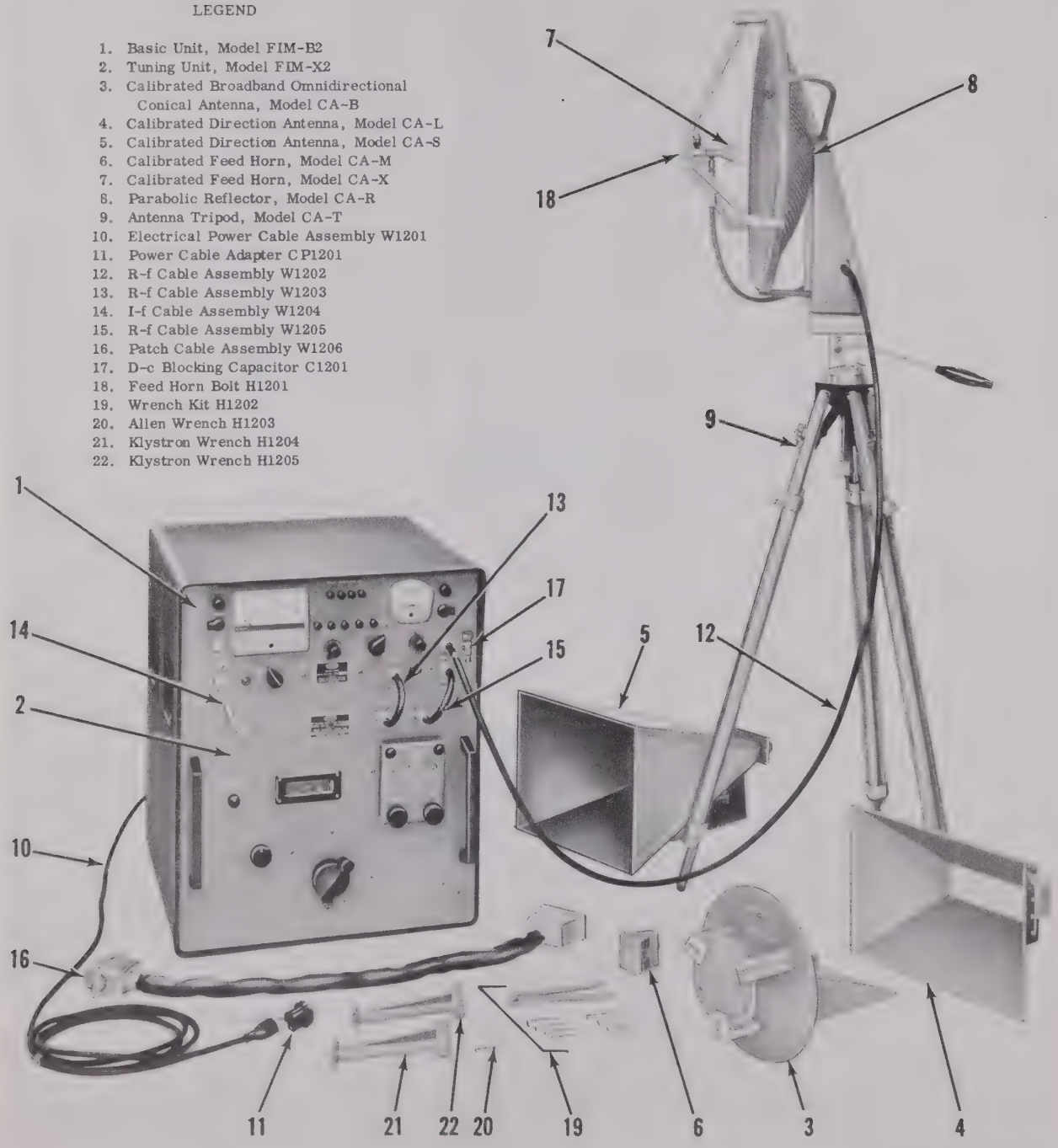
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Figure 1-1. Model FIM-2 Field Intensity Meter

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

3-2. The Model FIM-2 Field Intensity Meter is a sensitive and frequency selective triple conversion superheterodyne microwave receiver and calibrated microwave signal generator which covers the frequency range from 1,000 to 10,000 mc in four overlapping bands. It is used as a sensitive r-f voltmeter (power meter) to determine the absolute level of r-f signals. In addition to the usual microwave receiver circuitry, the FIM-2 contains the following:

a. A signal calibrator, physically contained within each Tuning Unit, for both calibrating the gain of the receiver section and for use as a calibrated microwave signal generator.

b. An r-f preselector, also physically contained within each Tuning Unit, and a high-frequency first i-f to ensure adequate image and spurious response rejection.

c. Calibrated attenuators (r-f: 0 to 60 db in 20-db steps, i-f: 0 to 20 db in 1-db steps) to extend the basic 20 to 1,000 microvolt input signal range to a maximum of three volts rms.

d. Automatic frequency control (afc) to compensate for incoming signal frequency drift.

e. Automatic gain control (agc) to provide an adequate dynamic range.

f. A calibrated output voltmeter having three scales (r-f microvolts, decibels above one microvolt, and decibels above one microvolt per megacycle).

g. Weighting circuits for the measurement of the average, quasi-peak, slideback-peak, or peak values of incoming r-f signals.

h. Audio, video, and recorder outputs.

i. An aural aid to facilitate the detection of unmodulated r-f signals.

3-3. NOT USED.

3-4. BLOCK DIAGRAM ANALYSIS, MICROWAVE RECEIVER OPERATION.

3-5. The incoming r-f signal under measurement is coupled to the RF IN jack and applied to the input of a coaxial r-f transfer switch, as shown in figure 3-1. When the FUNCTION SEL switch is in the OPERATE position, the signal is passed through the transfer switch and applied to the calibrated coaxial attenuators, which insert between 0 and 60 db of r-f attenuation in the incoming signal path (in 20-db steps, as determined by the r-f INPUT ATTENUATOR DB push-button switch depressed). The output of the calibrated attenuators is then fed to the input of the preselector via a front panel jumper cable.

3-6. That portion of the r-f signal under measurement which falls within the pass-band of the preselector is coupled to the first crystal mixer. Simultaneously, r-f energy from the first local oscillator, which is tuned to a frequency 260 mc away from the preselector, is also applied to the first crystal mixer. The non-linear characteristics of the crystal produces a 260-mc difference frequency signal (the first i-f), which is coupled to the 260/140-mc preamplifier via a fron panel jumper cable.

3-7. The 260/140-mc preamplifier amplifies the first i-f signal and heterodynes it with the 120-mc output of the crystal-controlled local oscillator, thus producing the second intermediate frequency

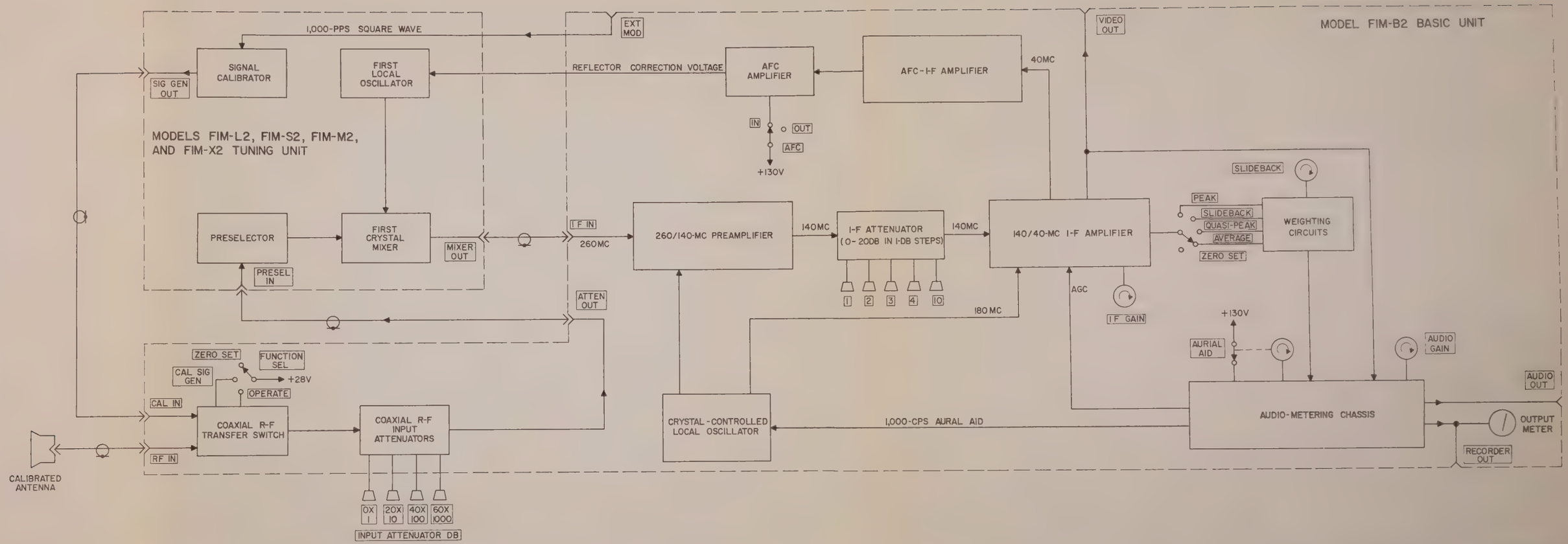

Figure 3-1. Model FIM-2 Field Intensity Meter, Simplified Block Diagram

signal centered at 140 mc.

3-8. The output of the 260/140-mc preamplifier is then applied to the 140-mc i-f attenuator, which provides i-f attenuation in 1-db steps from 0 to 20 db, as determined by the setting of the i-f Input Attenuator Db push-button switches. The output of the i-f attenuator is then fed to the 140/40-mc i-f amplifier.

3-9. The 140-mc output of the i-f attenuator is amplified and then mixed with the 180-mc output of the crystal-controlled local oscillator within the 140/40-mc i-f amplifier to produce the 40-mc third intermediate frequency signal. A portion of this signal is applied to the afc-i-f amplifier (see paragraph 3-10); the remainder is divided between two detectors, one supplying the weighting circuits (see paragraph 3-11) and the other supplying the audio amplifier portion of the audio-metering chassis (see paragraph 3-12) and the VIDEO OUT jack.

3-10. The nominally 40-mc third i-f signal applied to the afc-i-f amplifier is amplified, limited, and applied to afc discriminators. If the signal is not centered at 40 mc, a d-c error signal is generated and applied to the afc amplifier. This error signal is then amplified by the afc amplifier and, when the AFC switch is in the IN position, the amplified d-c error signal is superimposed upon the first local oscillator reflector voltage, thus causing the operating frequency of the klystron to shift in that direction which will maintain the third i-f signal at 40 mc. This "electronic tuning" keeps the FIM-2 tuned to the signal under measurement despite possible frequency drift of the incoming r-f signal.

3-11. That portion of the 40-mc third i-f signal which is detected and applied to the weighting circuit (determined by the position of the OUTPUT switch) produces an output signal proportional to the type

of measurement selected (i.e., average, quasi-peak, slideback-peak, or peak). This output signal is then applied to the audio-metering chassis where it is amplified and applied to both the output meter and the RECORDER OUT jack. The output meter provides a visual indication of the level of the r-f input signal under measurement, while the RECORDER OUT jack provides the facility for simultaneous recording of the output meter indication.

3-12. That portion of the detected 40-mc third i-f signal which is applied to the VIDEO OUT jack for external oscilloscope observation of the modulation component is also applied to the audio amplifier in the audio-metering chassis. Any audio-modulation present is amplified and coupled to the AUDIO OUT jack for monitoring through an external 600-ohm headset.

3-13. An aural tuning aid circuit is employed to facilitate the detection of unmodulated r-f signals by modulating the 120-mc output of the crystal-controlled local oscillator with a 1,000-cps audio signal. This circuit is energized when the AURAL AID control is rotated clockwise beyond its "off" position. The modulation can thus be monitored with the external headset that is connected to the AUDIO OUT jack.

3-14. BLOCK DIAGRAM ANALYSIS, MICROWAVE SIGNAL GENERATOR OPERATION.

3-15. When the FUNCTION SEL switch is set to the CAL SIG GEN position, the reflex klystron signal calibrator is energized. This signal calibrator is capable of generating either cw or 1,000-pps square-wave modulated cw signals. The amplitude of the cw signal is continuously variable between 0 and -95 dbm (0.223 volts rms to 5 microvolts), as determined by the setting of the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control, and is available at the SIG GEN OUT jack.

3-16. DETAILED THEORY OF OPERATION, TUNING UNITS.

3-17. The four Tuning Units are identical in principles of operation. Differences exist, due to the frequency range of each Tuning Unit, in the type of reflex klystron tubes, crystal mixers, and preselectors employed. In addition, to cover the Model FIM-L2 and Model FIM-X2 Tuning Unit frequency ranges with adequate output power, mode switching is employed in these Tuning Units. Table 3-1 is a convenient listing of the detailed differences that exist between the four Tuning Units. The reader should refer to the individual detailed schematic diagrams of the Tuning Units (figures 5-1 through 5-4) to note the actual circuit differences. Paragraphs 3-18 through 3-57 describe the Model FIM-X2 Tuning Unit.

3-18. PRESELECTOR.

3-19. The preselector (see figure 3-2 and 3-3) consists of two aperture-coupled cavities simultaneously tracked throughout the tuning range of the Model FIM-X2 Tuning Unit. The cavities operate as a 3/4-wavelength resonant line acting as a double-tuned network at the input of the Tuning Unit. In operation, the preselector is tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial by a single tuning cam actuated by the TUNING control through the precision mechanical drive system. Fine adjustment of the two preselector tuning plungers, one for each cavity, is accomplished by two tape cams mounted on a rack and gear assembly above the preselector, as shown in figure 3-3. This fine tuning capability provides incremental adjustment of the individual tuning plunger positions within the cavity through the action of two L-shaped rocker arms, thus precisely tuning the preselector at all points within the frequency range of the Tuning Unit.

TABLE 3-1. TUNING UNIT DIFFERENCE DATA.

Characteristic	Tuning Unit			
	Model FIM-L2	Model FIM-S2	Model FIM-M2	Model FIM-X2
Tuning range and signal calibrator frequency range (in megacycles)	1,000 to 2,240	2,140 to 4,340	4,200 to 7,740	7,360 to 10,000
First local oscillator frequency range (in megacycles)	1,260 to 2,500 (260 mc above sig. cal.)	2,400 to 4,600 (260 mc above sig. cal.)	4,460 to 8,000 (260 mc above sig. cal.)	7,100 to 9,740 (260 mc below sig. cal.)
Signal calibrator, first local oscillator, and preselector cavity mode (in wavelength)	1/4	3/4	3/4	3/4
Signal calibrator tube type	7505/ZV1010	7049/ZV1009	8052/ZV1011	8052/ZV1011
First Local oscillator tube type	7505/ZV1010	7049/ZV1009	8052/ZV1011	8052/ZV1011
Reflector mode switching	Required	Not required	Not required	Required
Signal calibrator reflector mode	a. 1-3/4 wave for frequencies below 1.3 kmc b. 2-3/4 wave for frequencies above 1.3 kmc	2-3/4 wave throughout the entire tuning range	2-3/4 wave throughout the entire tuning range	a. 3-3/4 wave for frequencies below 9.1 kmc b. 4-3/4 wave for frequencies above 9.1 kmc
First local oscillator reflector mode	a. 1-3/4 wave for frequencies below 1.56 kmc b. 2-3/4 wave for frequencies above 1.56 kmc	2-3/4 wave throughout the entire tuning range	2-3/4 wave throughout the entire tuning range	a. 3-3/4 wave for frequencies below 8.84 kmc b. 4-3/4 wave for frequencies above 8.84 kmc
Anode voltage	-325 volts	-325 volts	-1,000 volts	-1,250 volts
Control grid voltage*	+8 to +10 v	+8 to +10 v	+8 to +10 v	+8 to +10 v
Anode current	28ma	28 ma	20 ma	20 ma

* With respect to anode voltage.

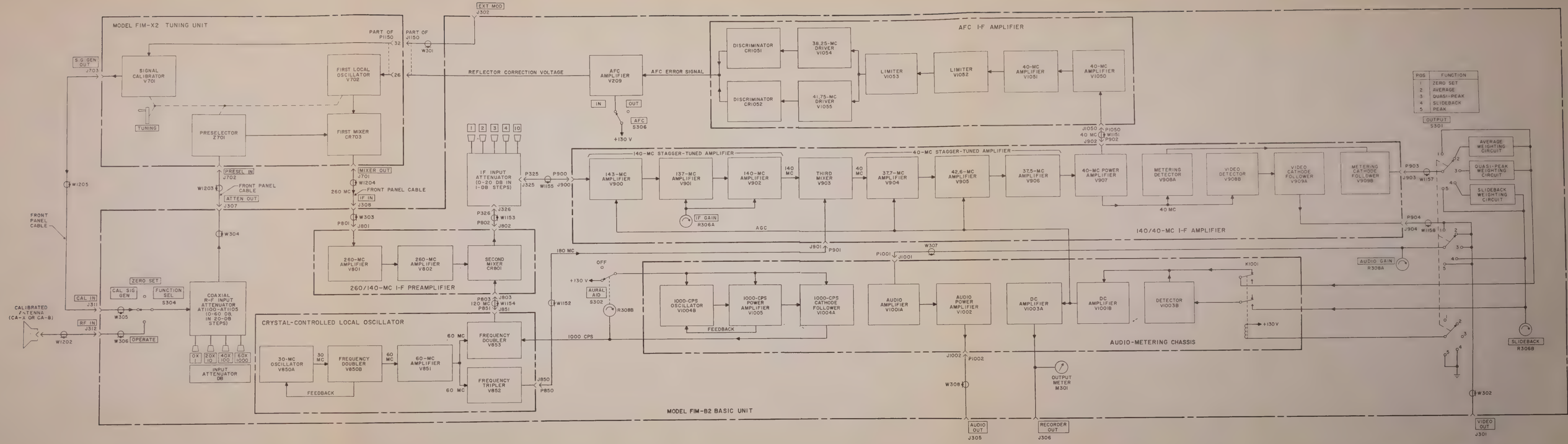

Figure 3-2. Model FIM-2 Field Intensity Meter, Detailed Block Diagram

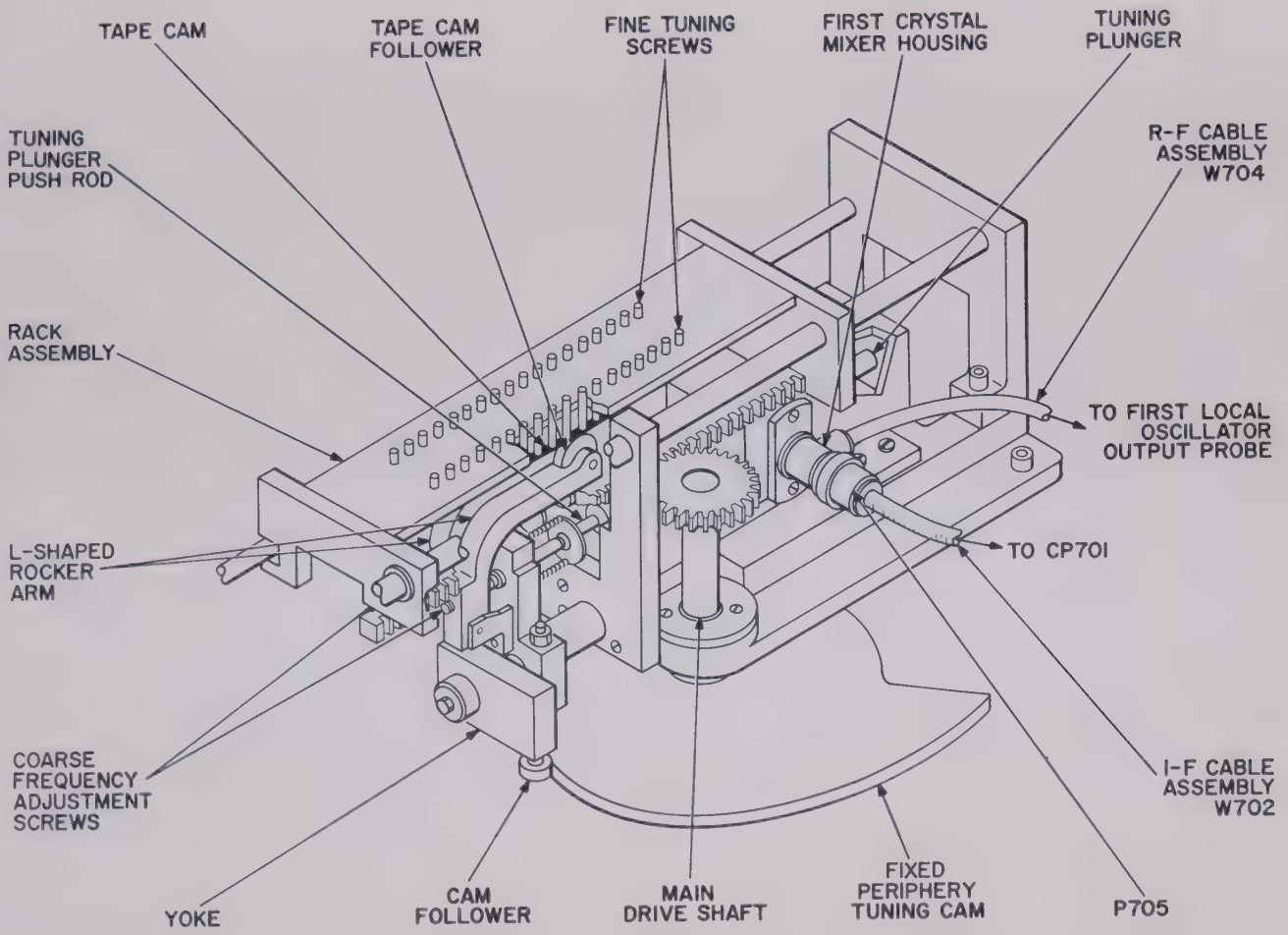

Figure 3-3. Model FIM-X2 Tuning Unit Preselector

3-20. In the Model FIM-L2 and Model FIM-S2 Tuning Units, a series of adjusting screws located at the top of the preselector (see figure 3-4) provide the facility for fine tuning of the preselector cavity. These screws are adjusted for each cavity to vary the capacitance between the preselector tuning plunger and the cavity wall.

3-21. FIRST LOCAL OSCILLATOR V702.

3-22. First local oscillator V702 is a reflex klystron tube operating in an external resonant cavity, as shown in figure 3-5. The cavity is in the form of a coaxial transmission line, and consists of two cylinders - one inside the other. The reflex klystron tube is inserted at one end of the cavity so that the outer cylinder makes contact with the first interaction grid (so termed because it is closer to the cathode). The spring fingers of the inner cylinder make contact with the second interaction grid. The circuit is completed at the other end of the cavity by a movable non-contacting shorting plunger of special construction. The position of this movable short determines the physical wavelength, and hence the operating frequency, of the cavity. The first local oscillator reflector voltage, which determines the exact electrical frequency of operation of the reflex klystron, is tracked with the movement of the shorting plunger by the precision mechanical drive system (see paragraph 3-53). Power is extracted from the cavity by loop coupling at a fixed point within the cavity.

3-23. FIRST LOCAL OSCILLATOR REFLECTOR VOLTAGE TRACKING CIRCUIT.

3-24. The frequency of operation of the first local oscillator is determined by both the physical wavelength of the external resonant cavity and the magnitude of the reflector (reflector to cathode)

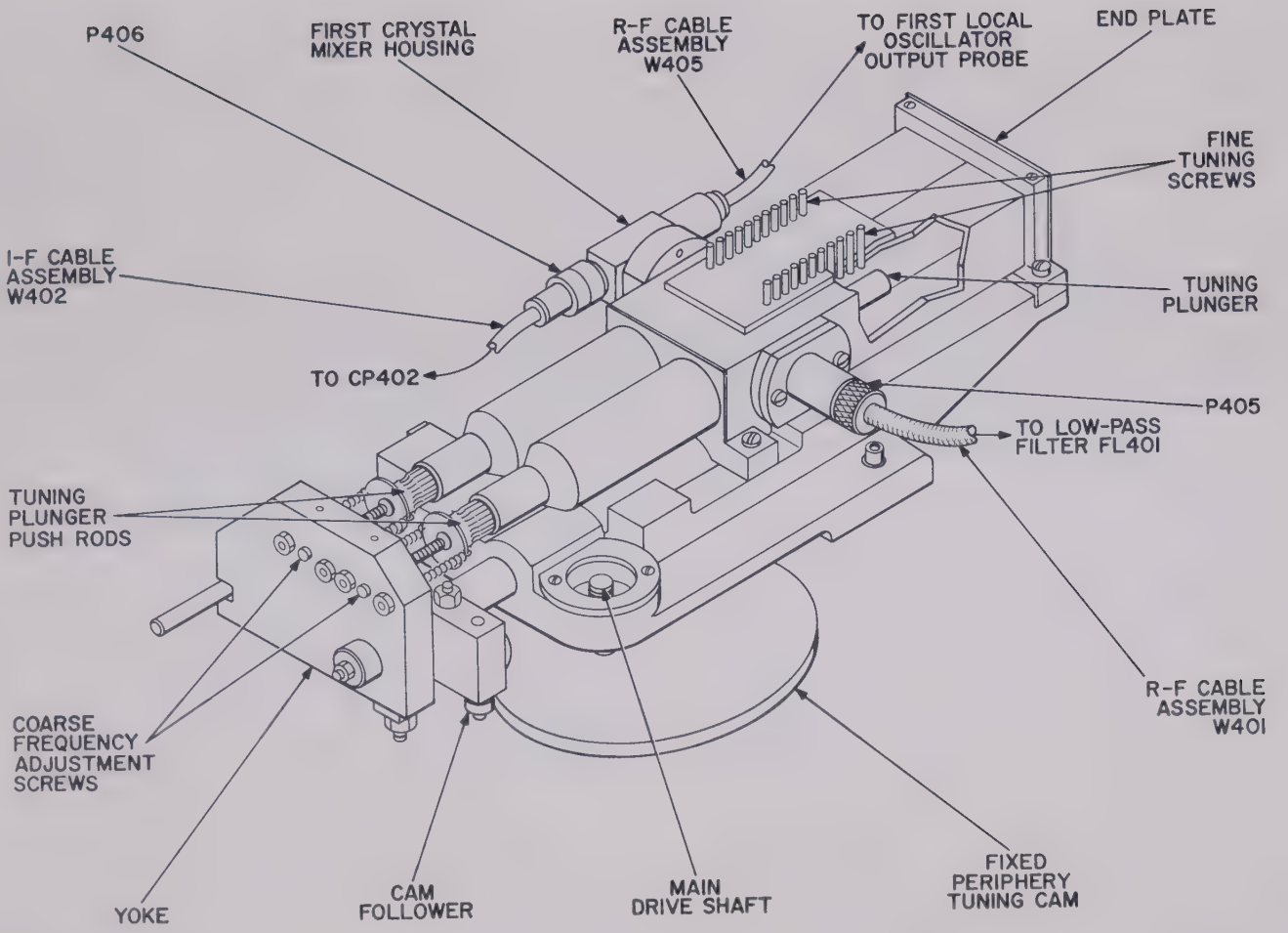

Figure 3-4. Model FIM-L2 Tuning Unit Preselector

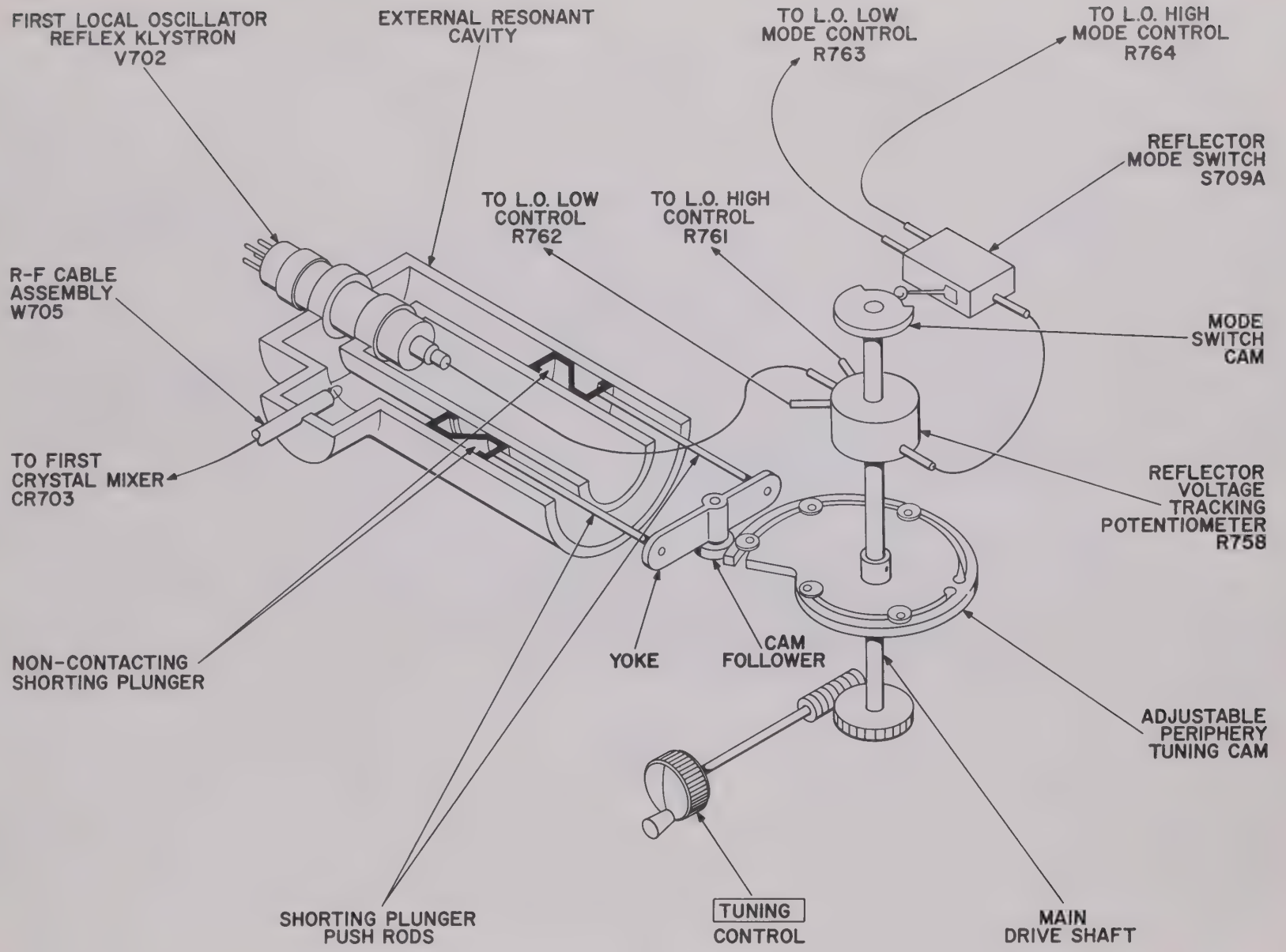

Figure 3-5. First Local Oscillator V702, Simplified Electromechanical Diagram

voltage. The d-c voltage applied to the reflector is controlled by wire-wound potentiometer R758. The wiper arm of this control is mechanically ganged to the movable non-contacting shorting plunger located in the first local oscillator external resonant cavity.

3-25. For a given setting of the resonant cavity, there is an optimum reflector voltage required for oscillation. The reflector voltage, therefore, must vary as the operating frequency of the first local oscillator is to be changed. As the frequency increases, the magnitude of the reflector voltage also increases (and vice versa) to maintain the maximum amplitude of oscillation. In the vicinity of 8,900 mc, the reflector voltage becomes excessively high and the power output of the reflex klystron drops. At this point it becomes advantageous to switch to the next higher reflector mode of operation.

3-26. This is accomplished by mode switch S709A without changing the frequency of operation of the first local oscillator. The reflector voltage is reduced so that the first local oscillator reflex klystron operates in the 4-3/4-wave reflector mode instead of the 3-3/4-wave mode. The 4-3/4-wave reflector mode is maintained throughout the remainder of the tuning range. Reflector mode switch S709A is activated by a teflon cam mounted on the control shaft of reflector voltage tracking potentiometer R758.

3-27. The resistors in the reflector voltage tracking circuit (R757 and R771) are selected to insure that the proper frequency-versus-voltage characteristics are obtained for the reflector electrode (see figure 3-6). Potentiometers R761, R762, R763, and R764, which are screwdriver adjusted, set the minimum and maximum voltages that can be applied to the reflector voltage tracking potentiometers.

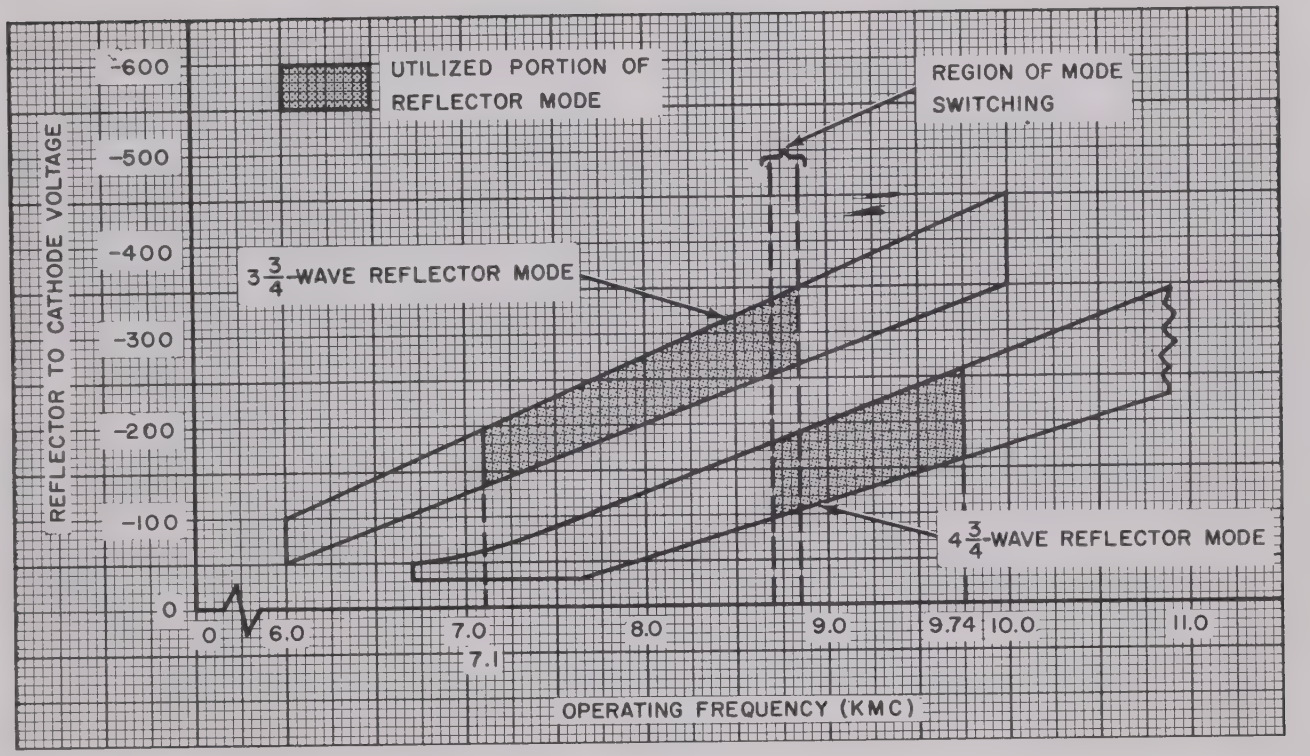

Figure 3-6. First Local Oscillator Frequency Versus Reflector Voltage Characteristic Curve

3-28. FIRST CRYSTAL MIXER CR703.

3-29. The r-f signal falling within the pass-band of the preselector and the r-f output of first local oscillator V702 are simultaneously applied to first crystal mixer CR703. Since the difference between these two signals is always 260 mc (see table 3-1), the non-linear characteristics of the crystal will produce the sum and difference frequencies of these two signals. The output of first crystal mixer CR703 is then coupled to the input of the 260/140-mc preamplifier (see paragraph 3-65) via MIXER OUT jack J701, i-f cable assembly W1204, and IF IN jack J308.

3-30. SIGNAL CALIBRATOR V701.

3-31. Signal calibrator V701 is a reflex klystron tube operating in an external resonant cavity in the same fashion as first local oscillator V702 (see paragraph 3-21). Unlike the first local oscillator, the signal calibrator is capable of supplying a calibrated r-f output signal which is adjustable over the range from 0.223 volts rms to 5 microvolts (0 to -95 dbm). This capability enables the FIM-2 to serve as a calibrated microwave signal generator, obviating the need for an external signal generator to calibrate the gain of the receiver portion of the system.

3-32. Signal calibrator V701 operates only when the FUNCTION SEL switch is set to the CAL SIG GEN position. For the other two positions of FUNCTION SEL switch S304, namely ZERO SET and OPERATE, the control grid of V701 is biased beyond cutoff, preventing the klystron from oscillating. When in operation, r-f energy is extracted from the external resonant cavity at two points: within the output attenuator waveguide-below-cutoff pipe and within the power set waveguide-beyond-cutoff pipe (see figure 3-7 and paragraph 3-36).

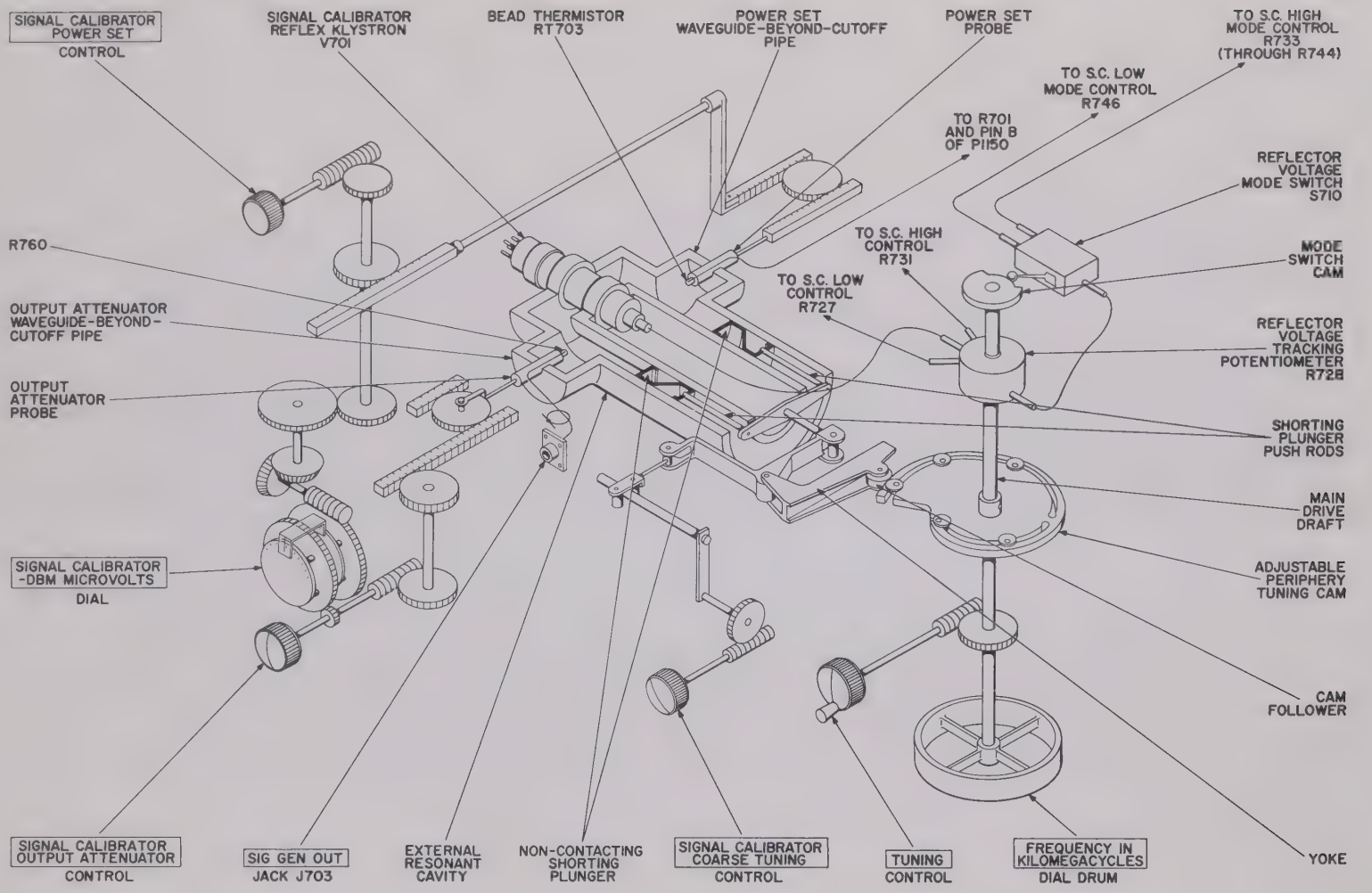
SIGNAL CALIBRATOR POWER SET CONTROL
SIGNAL CALIBRATOR REFLEX KLYSTRON V701
BEAD THERMISTOR RT703
POWER SET WAVEGUIDE-BEYOND-CUTOFF PIPE
POWER SET PROBE
TO S.C. HIGH MODE CONTROL R733 (THROUGH R744)
TO S.C. LOW MODE CONTROL R746
TO R701 AND PIN B OF P1150
REFLECTOR VOLTAGE MODE SWITCH S710
R760
TO S.C. HIGH CONTROL R731
MODE SWITCH CAM
TO S.C. LOW CONTROL R727
OUTPUT ATTENUATOR WAVEGUIDE-BEYOND-CUTOFF PIPE
REFLECTOR VOLTAGE TRACKING POTENTIOMETER R728
OUTPUT ATTENUATOR PROBE
SHORTING PLUNGER PUSH RODS
MAIN DRIVE DRAFT
SIGNAL CALIBRATOR -DBM MICROVOLTS DIAL
ADJUSTABLE PERIPHERY TUNING CAM
CAM FOLLOWER
SIGNAL CALIBRATOR OUTPUT ATTENUATOR CONTROL
SIG GEN OUT JACK J703
EXTERNAL RESONANT CAVITY
NON-CONTACTING SHORTING PLUNGER
SIGNAL CALIBRATOR COARSE TUNING CONTROL
TUNING CONTROL
FREQUENCY IN KILOMEGACYCLES DIAL DRUM
YOKE

Figure 3-7. Signal Calibrator V701, Simplified Electro-mechanical Diagram

3-33. Incremental adjustment of the signal calibrator external resonant cavity shorting plunger position, independent of the TUNING control and precision mechanical drive system, is accomplished by the SIGNAL CALIBRATOR COARSE TUNING control through a worm and gear assembly. This facility enables the cavity to be precisely tuned to a frequency 260 mc away from that of the first local oscillator and, at the same time, to the exact frequency to which the preselector is tuned.

3-34. SIGNAL CALIBRATOR REFLECTOR VOLTAGE TRACKING CIRCUIT.

3-35. In a manner similar to that for the first local oscillator (see paragraph 3-23), the signal calibrator reflector voltage is controlled by wire-wound potentiomenter R729. Resistors R744, R767, and R775 are selected to insure that the proper frequency-versus-voltage characteristics (see figure 3-6) are obtained for the reflector electrode. Potentiometers R727, R731, R733, and R746, which are screwdriver adjusted, in conjunction with the SIGNAL CALIBRATOR FINE TUNING control (R747A and R747B) limit the maximum and minimum voltages applied to the reflector voltage tracking potentiometer and permit fine adjustment of the reflector voltage when tuning the signal calibrator. Mode switching is accomplished in the vicinity of 9,100 mc by mode switch S710, which is actuated by a teflon cam mounted on the control shaft of reflector voltage tracking potentiometer R729.

3-36. SIGNAL CALIBRATOR POWER SET AND OUTPUT ATTENUATOR CONTROLS.

3-37. The SIGNAL CALIBRATOR POWER SET and SIGNAL CALIBRATOR OUTPUT ATTENUATOR controls determine the positions of the thermistor probe assembly within the power set waveguide-beyond-cutoff pipe and the output attenuator probe within the output attenuator waveguide-

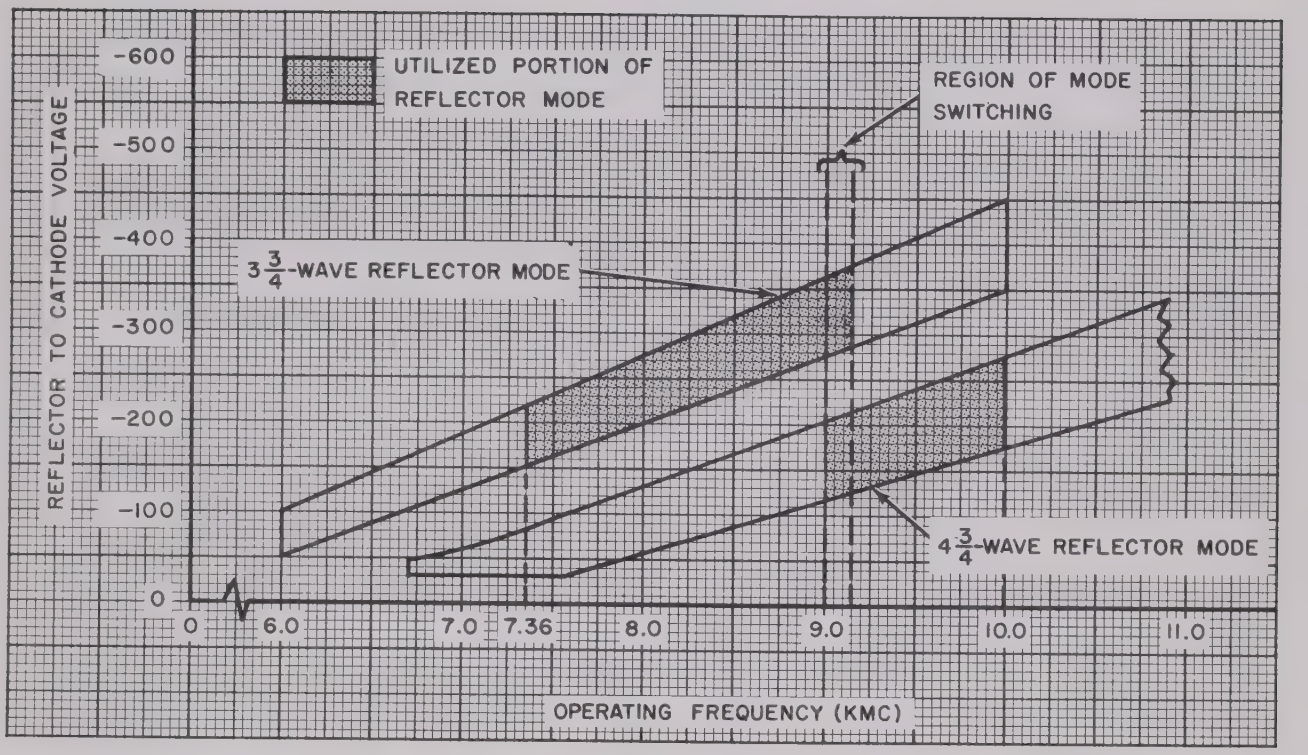

Figure 3-8. Signal Calibrator Frequency Versus Reflector Voltage Characteristic Curve

beyond-cutoff pipe, respectively. The SIGNAL CALIBRATOR POWER SET control simultaneously adjusts the position of the thermistor probe within the power set pipe and the position of the power set indicator hairline, as shown in figure 3-7. The SIGNAL CALIBRATOR OUTPUT ATTENUATOR control, which functions independently of the SIGNAL CALIBRATOR POWER SET control, simultaneously adjusts the position of the output attenuator probe within its pipe and the position of the -DBM MICROVOLTS dial, as shown in figure 3-7.

3-38. Rotation of the SIGNAL CALIBRATOR POWER SET control adjusts the position of the bead thermistor (see paragraph 3-39), and hence determines the amount of r-f power absorbed by the probe. This control is adjusted until the "cal" indication is obtained on the power monitor meter. When this adjustment has been made, the r-f power extracted by the output attenuator probe and coupled to the SIG GEN OUT jack can be read directly from the -DBM MICROVOLTS dial with an accuracy of ± 1 db.

3-39. THERMISTOR BRIDGE CIRCUIT.

3-40. The r-f power monitoring circuit consists of a Wheatstone-type bridge employing a variable resistance element (thermistor) as one of its arms. A thermistor has a negative temerature coefficient of resistance (i.e., its resistance decreases as its temperature increases, and vice versa). Changes in thermistor temperature (and hence resistance) are governed by three factors: thermal changes in its environment, the current flowing through it, and the r-f energy it absorbs.

3-41. By controlling two factors, namely the thermal change in its environment and the current passing through it, the thermistor can

be used to measure r-f energy by utilizing the change in resistance caused by the r-f energy it has absorbed.

3-42. Two types of thermistors are employed in the bridge and associated compensating circuitry (see figure 5-4); the bead type (RT703), which has a small mass and is affected by all the factors mentioned above, and the disc type (RT701 and RT702), which has a relatively greater mass and is highly sensitive to its environmental temperature while relatively insensitive to the current flowing through it.

3-43. The basic bridge circuit, which consists of resistors R701, R702, and R703 and thermistor RT703 (which is part of the thermistor probe assembly located in the power set waveguide-beyond-cutoff pipe), is balanced by adjusting power monitor meter ZERO SET control R312 when FUNCTION SEL switch S304 is in the ZERO SET position. Bridge Coarse Int. Adj. control R709 is factory set to permit the power monitor meter ZERO SET control to cover the entire range of the Tuning Unit. After the power monitor meter has been zero-set, and the FUNCTION SEL switch set to the CAL SIG GEN position, any r-f power fed into the power set waveguide-beyond-cutoff pipe will be absorbed by the bead thermistor, thereby changing its resistance and unbalancing the bridge.

3-44. The bridge and its associated circuitry is so designed that, at a particular frequency, the thermistor probe must be inserted a definite amount within the power set waveguide-beyond-cutoff pipe for the thermistor to absorb one milliwatt of r-f power. When one milliwatt is absorbed, the power monitor meter pointer will deflect to an indication of "cal," as indicated on the correction curves supplied with the Model FIM-X2 Tuning Unit.

3-45. Disc thermistors RT701 and RT702, which are located on a thermistor mount attached to the power set pipe, are compensating devices. RT701, in combination with resistors R704 and R706, acts to correct any d-c unbalance due to changes in ambient temperature. RT702, in combination with resistors R707 and R708, acts to correct any change in power monitor meter sensitivity caused by changes in ambient temperature.

3-46. PROTECTIVE DIODES CR701 AND CR702.

3-47. Protective diodes CR701 and CR702, which are connected between the reflector and cathode of first local oscillator V702 and signal calibrator V701, respectively, as shown in figure 5-4, are employed to prevent possible damage to the reflex klystrons should the reflectors somehow become positive with respect to the cathode. Reference to the schematic diagram , figure 5-4, shows that the cathode of protective diode CR701 is connected directly to the cathode of V702 (similarly for CR702 and V701), to which the anode voltage is applied. Since the anode of CR701 is connected directly to the reflector of V702 (the same holds true for CR702 and V701), any circuit disturbance causing the reflector to become more positive than the cathode will drive the protective diode into conduction. In this manner, the maximum positive voltage appearing at the reflector (with respect to the cathode) will be the small voltage drop across the conducting protective diode. This circuitry thereby prevents the possible destruction of the reflex klystron when the reflector accidentally becomes more positive than the cathode.

3-48. GRID BIAS ADJUST CONTROLS.

3-49. The reflex klystron grid bias, which determines the amount of current drawn by the tube, and hence the r-f power developed, is controlled by a network of dropping resistors and a screwdriver adjusted potentiometer. Normal operating bias voltages for both the first local oscillator and the signal calibrator varies between +8 and +10 volts with respect to the cathode (see table 3-1). The signal calibrator grid bias voltage is obtained from the anode supply via the voltage divider network comprised of resistors R711, R712, R777, R778, R782, and S.C. Bias control R713. In a similar fashion, the first local oscillator grid bias voltage is obtained from the voltage divider network comprised of resistors R716, R717, R772, R779, R781, and L.O. Bias control R714.

3-50. When the FUNCTION SEL switch is set to either the ZERO SET or OPERATE position, the voltage appearing at the control grid of V701 lies between -1,250 and -1,850 volts, as determined by the voltage divider network comprised of resistors R748, R749, R750, and R752, which are connected across the reflector and anode supplies. This negative voltage is sufficient to bias the reflex klystron beyond cutoff.

3-51. CURRENT ADJUST CONTROLS.

3-52. Low I Adj. control R743 and High I Adj. control R766, in conjunction with switch S709B, are employed to maintain the current drawn from the reflector supply at a constant level of 7 ma. These controls, which are screwdriver adjusted, enable the afc amplifier (see paragraph 3-87) to operate at its optimum point. These current adjusting controls are employed in each Tuning Unit, thereby permitting the afc amplifier to perform independently of the Tuning Unit in use.

3-53. PRECISION MECHANICAL DRIVE SYSTEM.

3-54. The precision mechanical drive system (UNIDIAL®) simultaneously tracks the preselector, the first local oscillator external resonant cavity, the first local oscillator reflector voltage, the signal calibrator external resonant cavity, the signal calibrator reflector voltage, and the FREQUENCY IN KILOMEGACYCLES dial with rotation of the TUNING control. This drive system consists of a main drive shaft three tuning cams (two of which are of the adjustable periphery type[1]), and a precision gear assembly. Through the precision mechanical drive system the rotational motion imparted to the TUNING control by the operator is converted to the required translational motion required to track the preselector and external resonant cavities as well as the rotational motion necessary to drive the reflector voltage tracking potentiometers, the FREQUENCY IN KILOMEGACYCLES dial, and the mode switch cams.

3-55. Rotation of the preselector tuning cam (see figure 3-3), which is of the fixed periphery type, causes its cam follower to drive the preselector yoke. The yoke, in turn moves the preselector tuning plungers, thereby determining the physical wavelength of the preselector cavities.

3-56. In a manner similar to that for the preselector, the first local oscillator and signal calibrator tuning cams, which are both of the adjustable periphery type, drive their respective cam followers. These, in turn, move the yokes which position the movable noncontacting shorts within the signal calibrator and first local oscillator external resonant cavities, as shown in figures 3-5 and 3- 7 .

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[1] U. S. Patent No. 2,824,466.

3-57. Because simultaneous tracking of all three Tuning Unit components, namely the preselector, the first local oscillator, and the signal calibrator, would require a myriad of tracking adjustments, the precision mechanical drive system tightly tracks only the preselector and first local oscillator simultaneously, while the signal calibrator is loosely tracked with the above two components. In this manner, the frequency difference between the first local oscillator and the preselector is always maintained at exactly 260 mc. The operating frequency of the signal calibrator is adjusted, by means of the SIGNAL CALIBRATOR COARSE TUNING and SIGNAL CALIBRATOR FINE TUNING controls, to the exact frequency of the preselector (see paragraphs 3-30 and 3-34).

3-58. DETAILED THEORY OF OPERATION, BASIC UNIT.

3-59. The Basic Unit is the control and monitoring section of the FIM-2 system. It contains an electrically operated coaxial r-f transfer switch, two electrically operated coaxial input attenuator switches and six calibrated coaxial r-f attenuators, a 260/140-mc preamplifier, a crystal-controlled local oscillator, a 140-mc i-f attenuator, a 140/40-mc i-f amplifier, an afc-i-f amplifier, a multiple position output selector switch and the associated weighting circuitry for the measurement of the average, quasi-peak, slideback-peak, and peak measurements of incoming r-f signals, a calibrated output voltmeter for visually displaying the magnitude of the measured signal, an audio-metering chassis, a meter adjust board and power monitor meter for monitoring the operating voltages and currents generated within the equipment, a low-voltage power supply, a high-voltage power supply, and an afc amplifier. These components of the Basic Unit are described in detail in the following paragraphs.

3-60. COAXIAL R-F TRANSFER SWITCH S1101.

3-61. Electrically operated coaxial r-f transfer switch S1101 (see figures 3-2 and 5-6) is connected between CAL IN jack J311, RF IN jack J312, and the input to coaxial input attenuator switch S1102. Operation of S1101 is dependent upon the position of FUNCTION SEL switch S304, as described below.

a. When the FUNCTION SEL switch is in the ZERO SET position, both switching relays of coaxial r-f transfer switch S1101 are unenergized, forming open circuits between both the CAL IN and RF IN jacks and the receiver section of the FIM-2. Simultaneously, the control grid of the signal calibrator reflex klystron is biased beyond cutoff, preventing the generation of r-f energy. Under these conditions, adjustment of the power monitor meter ZERO SET control permits zero-setting the power monitor meter.

b. When the FUNCTION SEL switch is in the CAL SIG GEN position, +28-volts is applied to the terminals of switching relay A, causing the relay to become energized and coupling the output of the signal calibrator to the input of the r-f attenuators. The r-f signal from the RF IN jack is open-circuited and cannot be transferred to the remainder of the Basic Unit r-f circuitry.

c. When the FUNCTION SEL switch is in the OPERATE position, +28-volts is applied to the terminals of switching relay B, causing the relay to become energized and coupling the r-f signal under measurement from the RF IN jack to the input of the r-f attenuators. As in the ZERO SET position, the signal calibrator is once again biased beyond cutoff.

3-62. R-F INPUT ATTENUATOR.

3-63. The r-f input attenuator network (seeffigures 3-2 and 5-6) consists of coaxial input attenuator switches S1102 and S1103, six calibrated coaxial r-f attenuators, and the cable assemblies necessary to interconnect these components. The amount of r-f attenuation inserted by this network between the r-f signal (either from the calibrated antenna through the RF IN jack or from the signal calibrator through the CAL IN jack) is controlled by the r-f INPUT ATTENUATOR DB push-button switches, S305, as listed below in table 3-2.

TABLE 3-2. R-F ATTENUATION AS A FUNCTION OF PUSH-BUTTON SWITCH DEPRESSED.

R-f INPUT ATTENUATOR DB Push-button Switch Depressed	Calibrated Coaxial Input Attenuator(s) Inserted	Total R-f Attenuation Inserted
0X1	None	0 db
20X10	AT1100	20 db
40X100	AT1101 and AT1102	40 db
60X1000	AT1103, AT1104, and AT1105	60 db

3-64. The signal that is available at the output connector of coaxial input attenuator switch S1103 is then coupled to the front panel ATTEN OUT jack J307 via r-f cable assembly W304.

3-65. 260/140-MC PREAMPLIFIER.

3-66. The 260/140-mc preamplifier (see figures 3-2, 5-5, and 5-8) is a combination fixed-tuned two-stage grounded-grid amplifier and frequency converter. It generates the second intermediate frequency

signal by heterodyning the first i-f signal with the 120-mc output of the crystal-controlled local oscillator.

3-67. The signal coupled through input connector J801 consists not only of the 260-mc first i-f signal, but also the sum and difference frequencies of the r-f signal under measurement and the harmonic outputs of the first local oscillator. These signals ride on a d-c level created by the first crystal mixer. The d-c current is returned to the first crystal mixer through the low-pass filter network consisting of inductors L809, L812, and L815 and capacitors C805 and C810.

3-68. The remainder of the signal is then applied to the cathode of grounded-grid i-f amplifier V801 through a broadly tuned impedance matching network comprised of tapped coil L801 and capacitors C801 and C818. This network filters out the undesired responses created by the harmonics of the first local oscillator and passes only the desired first i-f signal which is centered at 260 mc.

3-69. The output of V801 is transformer coupled via T801, which is tuned to 260 mc, to the cathode of grounded-grid i-f amplifier V802 for another stage of amplification. The output of V802 is then applied to the primary of transformer T802, which is also tuned to 260 mc.

3-70. The 120-mc output of the crystal-controlled local oscillator (see paragraph 3-89) is applied through input connector J803 to the voltage divider network comprised of resistors R803 and R804. This network adjusts the amplitude of the 120-mc signal to the optimum value required for mixing. This signal is then fed to second crystal mixer CR801 through the secondary of T802. CR801, being a nonlinear device, heterodynes the 260- and 120-mc signals to produce their sum and difference frequencies. The 140-mc difference signal

is coupled through the bandpass filter consisting of inductor L808 and capacitor C817 and applied to output jack J802. The second i-f signal is then coupled to input connector J326 of the 140-mc i-f attenuator (see paragraph 3-71) via i-f cable assembly W1153.

3-71. 140-MC I-F ATTENUATOR.

3-72. The 140-mc i-f attenuator (see figures 3-2, 5-5, and 5-8) consists of five compensated pi-section resistive attenuators, each individually controlled by an i-f Input Attenuator Db push-button switch. The amount of i-f attenuation inserted into the i-f line is adjustable from 0 to 20 db in 1-db steps. The output, which is available at J325, is then coupled to input jack J900 of the 140/40-mc i-f amplifier (see paragraph 3-73) through i-f cable assembly W1155.

3-73. 140/40-MC I-F AMPLIFIER.

3-74. The 140/40-mc i-f amplifier (see figures 3-2, 5-5, and 5-8) contains a 140-mc stagger-tuned section, a mixer, a 40-mc stagger-tuned section, a power amplifier, two detectors, and two cathode followers.

3-75. The second i-f signal from the 140-mc i-f attenuator is coupled through input jack J900 and coupling capacitor C900 and applied to the control grid of V900, the first stage of a three-stage stagger-tuned amplifier section. The output of V900, taken across the 143-mc plate tank circuit comprised of inductor L903 and capacitor C907, is coupled to the control grid of V901. The output of this second stage is taken across the 137-mc plate tank circuit consisting of inductor L906 and capacitor C916 and fed to the control grid of the third and final stage, V902. The output of V902 is taken across inductor L911, which, in conjunction with the stray capacitance as-

sociated with the inductor, is tuned to 140 mc, and applied to the control grid of third mixer V903.

3-76. Simultaneously, the 180-mc output of the crystal-controlled local oscillator (see paragraph 3-89) is applied to the primary of transformer T900, which is tuned to 180 mc, through input jack J901. The 180-mc signal appearing across the secondary of T900 is applied through coupling capacitor C927 to the control grid of V903. This 180-mc signal and the 140-mc output of V902 are mixed within V903 to yield the third and final i-f signal which is centered at 40 mc.

3-77. The output of third mixer V903 is taken across the 42.3-mc plate tank circuit comprised of inductor L915 and capacitor C934 and applied to the control grid of V904, the first stage of a three-stage stagger-tuned amplifier section. The output of V904 is taken across the 37.7-mc plate tank circuit comprised of inductor L919 and capacitor C954 and applied to the control grid of V905. The output of this stage is taken across the 42.6-mc plate tank circuit consisting of inductor L923 and capacitor C952 and applied to the control grid of V906, the last stage of amplification in the stagger-tuned amplifier section. The output of V906 is taken across the 37.5-mc plate tank circuit consisting of inductor L929 and capacitor C959 and applied to the control grid of power amplifier V907.

3-78. The 40-mc center frequency output of V907 is then fed to three circuits, as described below.

a. The output of V907 is taken across the primary of transformer T901, which is tuned to 40 mc, and applied to the plate of video detector V908B. The detected output appearing at the cathode is then applied to the i-f filter and video peaking network comprised of capacitor C969 and inductor L935, taken across resistor R933 and fed to the control grid of video cathode follower V909A.

V909A acts as an impedance matching device and feeds VIDEO OUT jack J301 and AUDIO OUT jack J305, the latter through the audio amplifier circuitry of the audio-metering chassis (see paragraph 3-96), via output jack J904.

b. The output of V907 is also taken across inductor L936 and applied to the cathode of metering detector V908A. The detected output appearing at the plate is coupled through the i-f filter and series peaking network comprised of capacitor C972, inductor L950, and resistor R990, taken across load resistor R938, and directly coupled to the control grid of metering cathode follower V909B. The output of V909B, which serves as an impedance matching device, is then applied, via output jack J903 and video cable assembly W1157, to the wiper arm of OUTPUT switch S301C, which applies the detected metering signal to the selected weighting circuit (see paragraph 3-101).

c. The output of V907 is also taken across the secondary of transformer T901 and coupled through a 3-db pad, comprised of resistors R928, R929, and R931, and applied through output jack J902 and i-f cable assembly W1151 to the input of the afc-i-f amplifier (see paragraph 3-80).

3-79. The overall gain of the 140/40-mc i-f amplifier is controlled by IF GAIN control R306A, which adjusts the d-c voltage appearing at the cathodes of V901 and V902. Linear operation is obtained through Scale Tracking control R368 (located on the meter adjust board), which varies the cathode load of V904 and V905. Further control of the linearity of the amplifier is provided by an agc signal applied to the control grids of V900, V904, and V905. This agc signal is obtained from the audio-metering chasis (see paragraph 3-96).

3-80. AFC-I-F AMPLIFIER.

3-81. The afc-i-f amplifier (see figures 3-2, 5-5, and 5-8) consists of two stages of amplification, two series limiters, two parallel drivers, and two crystal discriminator networks, and is employed to generate a d-c error signal when the third i-f signal differs from the desired value of 40 mc. The d-c error signal is then applied to the afc amplifier (see paragraph 3-87), which supplies a corrective voltage to the first local oscillator reflector.

3-82. The nominally 40-mc signal received from the 140/40-mc i-f amplifier via input connector J1050 is coupled through a 3-db pad consisting of resistors R1050, R1051, and R1052, and applied to the primary of transformer T1050, which is tuned to 40 mc. The signal appearing across the secondary is coupled to the control grid of V1050. The voltage across inductor L1050, which, in conjunction with its associated stray capacitance, is tuned to 40 mc, is fed to the control grid of V1051. The output of this stage is taken across inductor L1052, which is also tuned to 40 mc through its stray capacitance, and coupled to the control grid of limiter V1052.

3-83. The 40-mc signal is clipped within limiter V1052, which has its control grid driven beyond cutoff during a portion of the negative half-cycle of the signal. This clipping action reduces the noise level of the negative half-cycle. The output of V1052, which has been shifted 180-degrees, is then applied to the control grid of limiter V1053, which clips the other half-cycle of the 40-mc signal. The output of V1053 is taken across the 40-mc tuned plate circuit comprised of inductor L1056, resistor R1069, and the associated stray capacitance, and fed to the parallel control grids of drivers V1054 and V1055.

3-84. The output of V1054 is taken across the 38.25-mc tuned plate circuit consisting of inductor L1058, capacitor C1069, and resistor R1076, and applied to the discriminator network containing crystal diode CR1051 and inductor L1065. The output of V1055 is taken across the 41.75-mc tuned plate citcuit comprised of inductor L1061, resistor R1081, and capacitor C1073, and fed to the discriminator network consisting of crystal diode CR1050 and inductor L1064.

3-85. The detected outputs of the discriminator networks are then filtered by the pi-section filters consisting of capacitors C1079, C1082, C1083, and C1084 and inductors L1066 and L1068. These filters produce a pure d-c voltage across resistor R1083. The magnitude and polarity of this voltage is proportional to the frequency deviation from the desired 40-mc third i-f center frequency, as follows.

a. When the third i-f signal applied to the afc-i-f amplifier is exactly 40 mc, the outputs of both discriminators are equal, both in magnitude and polarity. This condition results in no afc error signal, for the incoming third i-f is 40 mc.

b. When the third i-f signal applied to the afc-i-f amplifier is slightly greater than 40 mc, the output of the 41.75-mc driver, V1055, will be greater than that of V1054. In this manner the output of the high-frequency discriminator (CR1050 and its associated circuitry) will be greater than that of the low-frequency discriminator. This results in a d-c error signal that is more positive at pin A of connector P1051 than at pin D.

c. Conversely, when the third i-f signal applied to the afc-i-f amplifier is slightly less than 40 mc, the output of the 38.25-mc driver, V1054, will be greater than that of V1055. In this manner the output of the low-frequency discriminator (CR1051 and its associated circuitry) will be greater than that of the high-frequency dis-

criminator, resulting in a d-c error signal that is more positive at pin D of connector J1051 than at pin A.

3-86. The d-c error signal thus generated is applied to the afc amplifier (see paragraph 3-87). This error signal is available at all times and is independent of the position of AFC switch S306.

3-87. AFC AMPLIFIER.

3-88. Afc amplifier V209 (see figures 3-2 and 5-7) and its associated circuitry is provided to permit automatic frequency control (afc) of the first local oscillator when the AFC switch is set to the IN position. When AFC switch S306 is set to the OUT position, relay K201 is unenergized and the output of the reflector supply (see paragraph 3-127) is applied directly to the first local oscillator reflector tracking circuit (see paragraph 3-23). When the AFC switch is set to the IN position, however, relay K201 is energized, causing the d-c error signal from the afc-i-f amplifier to be amplified by V209. The amplified error signal is superimposed upon the reflector supply voltage, the resulting reflector voltage level then causes to operating frequency of the first local oscillator to shift in that direction which will return the first i-f signal to 260 mc (and hence the third i-f signal to 40 mc).

3-89. CRYSTAL-CONTROLLED LOCAL OSCILLATOR.

3-90. The crystal-controlled local oscillator (see figures 3-2, 5-5, and 5-8) consists of three sections: a 30-mc oscillator and frequency doubler, a frequency doubler which produces the 120-mc signal applied to the 260/140-mc preamplifier (see paragraph 3-65), and a frequency tripler which provides the 180-mc signal applied to the 140/40-mc i-f amplifier (see paragraph 3-73).

3-91. The 30-mc oscillator and frequency doubler section consists of oscillator V850A, frequency doubler V850B, and crystal Y850. The output of V850A is taken across the 30-mc tuned plate circuit comprised of inductor L851 and capacitor C851 and coupled to the control grid of frequency doubler V850B. The output of V850B, appearing across cathode resistor R851, is coupled through 30-mc crystal Y850 to the cathode of V850A, thereby sustaining oscillations at the desired frequency of 30 mc.

3-92. The second harmonic component of the output of V850B is taken across the 60-mc tuned plate circuit consisting of inductor L852 and capacitor C853 and applied to the control grid of amplifier V851. The amplified 60-mc output is taken across the 60-mc tuned plate circuit comprised of inductor L854, capacitor C856, and resistor R854, and coupled to the control grids of both frequency doubler V853 and frequency tripler V852.

3-93. The output of V853 is taken across the 120-mc tuned secondary of transformer T851 and applied through output jack J851 and i-f cable assembly W1154 to the 260/140-mc preamplifier.

3-94. The output of V852 is taken across the 180-mc tuned secondary of transformer T850 and applied through output connector J850 and i-f cable assembly W1152 to the 140/40-mc i-f amplifier.

3-95. Artificial modulation of the second i-f signal is accomplished by superimposing a 1,000-cps audio signal, generated in the audio-metering chassis (see paragraph 3-98), on the control grid of frequency doubler V853. The magnitude of this aural aid signal is controlled by AURAL AID control R308B and switch S302.

3-96. AUDIO-METERING CHASSIS.

3-97. The audio-metering chassis (see figures 3-2, 5-5, and 5-8) contains the circuitry required to develop an aural tuning aid signal of 1,000 cps, an audio amplifier, and the metering circuitry required to convert the output of the weighting circuits (see paragraph 3-101) to a signal suitable for application to output meter M301.

3-98. AURAL AID CIRCUIT. The aural aid circuit consists of cathode follower V1004A, audio oscillator V1004B, and feedback amplifier V1005. This circuit is energized when AURAL AID control R308A is rotated clockwise beyond its "off" position, thereby closing AURAL AID switch S302 and applying +130 volts to the plates of these tubes.

3-99. Audio oscillator V1004B is a cathode follower having its output taken across resistor R1014. This signal is applied to the RC phase-shift network consisting of resistors R1015, R1016, and R1021 and capacitors C1006, C1007, and C1008. This network produces a 180-degree phase shift when the signal applied to it is 1,000 cps. Its output is applied to the control grid of feedback amplifier V1005, which shifts the phase of the signal another 180-degrees. The resulting output of V1005 is coupled back to the control grid of audio oscillator V1004B, thereby sustaining oscillations, and to the control grid of audio amplifier V1004A. The cathode load resistance, AURAL AID control R308A, determines the amplitude of the 1,000-cps signal applied to the crystal-controlled local oscillator (see paragraph 3-89) for artificial modulation of the i-f signal.

3-100. AUDIO AMPLIFIER CIRCUIT. The audio amplifier circuit consists of audio amplifier V1001A and audio power amplifier V1002. This circuit amplifies the modulation envelope of the detected video signal obtained from video cathode follower V909A (see paragraph 3-78)

when the OUTPUT switch is in the AVERAGE, QUASI-PEAK, or SLIDEBACK position. Audio amplifier V1001A is a self-biased triode amplifier whose cathode resistor is unbypassed, thereby introducing negative feedback which results in less distortion of the signal being amplified. The output of V1001A is coupled to the control grid of audio power amplifier V1005, a conventional pentode power amplifier having an impedance matching transformer as its load. The output of V1005, which appears across the secondary of T1001, is coupled through output connector J1002 and cable assembly W308 to AUDIO OUT jack J308, where the modulation may be monitored through a 600-ohm headset.

3-101. METERING CIRCUIT. The metering circuit consists of relay K1001, pulse detector V1003B, d-c amplifiers V1001B and V1003A, and OUTPUT switch S301 and its associated circuitry.

3-102. When OUTPUT switch S301 is set to the ZERO SET position, the detected 40-mc signal from metering cathode follower V909B (see paragraph 3-89) is coupled through S301C to the wiper of S301D. Since there is no connection to pin 1 of S301D, no signal is applied to the d-c amplifiers. This position of the OUTPUT switch permits zero-setting of output meter M301 by means of output meter ZERO SET control R310.

3-103. When the OUTPUT switch is in the AVERAGE position, the detected metering signal is coupled through deck C to the average weighting circuit consisting of resistor R321 and capacitor C307. This circuit has a fast charge time and a slow discharge time for the detected i-f carrier and therefore responds to the peak of the detected i-f carrier. The discharge time is fast, however, for any modulation component, so that the output of the weighting circuit will follow the modulation. The resultant output will therefore be the average value of the modulation. This signal is coupled, through

S301B, to the audio-metering chassis connector P1003, pin H.

3-104. When the OUTPUT switch is in the QUASI-PEAK position, the detected 40-mc signal is coupled through deck C to the quasi-peak weighting circuit comprised of crystal diode CR303, resistors R323 and R324, and capacitors C308 and C309. This circuit has a slow charge time for the applied i-f carrier and an intermediate charge time for conventional pulse repetition rates. The discharge time, however, is slow for both. The amplitude response of this weighting circuit is thus directly proportional to the prf of the detected 40-mc signal (when the amplitude of the signal remains constant), and indicates the interference capability (nuisance value) of the signal. The output of this circuit is coupled through S301B to the audio-metering chassis via pin H of P1003.

3-105. When the OUTPUT switch is in the SLIDEBACK position, the detected 40-mc signal is coupled through deck C to the slideback-peak weighting circuit comprised of resistor R325, capacitor C301, crystal diode CR301, and SLIDEBACK control R306B. This circuit is similar to the average weighting circuit in that its time constants are alike. The SLIDEBACK control is adjusted, in conjunction with the AUDIO GAIN and AURAL AID controls, so that the signal heard in the headset just vanishes. When this occurs, the biasing voltage obtained from the -140-volt supply is equal to the peak value of the detected 40-mc signal. This bias voltage is then coupled to the audio-metering chassis through pin H of P1003.

3-106. When the OUTPUT switch is in the PEAK position, the detected 40-mc signal is coupled through deck C directly to deck B. The signal is then applied to pin H of audio-metering chassis connector P1003.

3-107. The signal coupled to pin H of audio-metering connector P1003 is applied to the junction of relay K1001, pin 7, and the cathode of pulse detector V1003B. When the OUTPUT switch is in the ZERO SET, AVERAGE, or QUASI-PEAK position, relay K1001 is unenergized and the output signal from the weighting circuit is coupled to the grid of d-c amplifier V1001B. For the other two positions of the OUTPUT switch, namely SLIDEBACK and PEAK, the signal is coupled through pulse detector V1003B and the weighting circuit comprised of resistor R1011 and capacitors C1004 and C1005 to the control grid of d-c amplifier V1001B.

3-108. D-c amplifier V1001B is a cathode follower whose output is taken across resistor R1008. The output signal serves the dual function of driving d-c amplifier V1003A and providing an agc signal for the 140/40-mc i-f amplifier (see paragraph 3-73). The output of V1003A is obtained between the wiper arm of output meter ZERO SET control R310 and ground, and is applied through Meter Sensitivity control R351 (see paragraph 3-113) to output meter M301. The output meter scales are calibrated to permit direct evaluation of the strength of the signal being measured and is calibrated in microvolts, decibels above one microvolt, and decibels above one microvolt per megacycle.

3-109. The small contact potential that exists between the plate and cathode of pulse detector V1003B is compensated for by contact potential adjust control R1021. In this manner, the small potential present does not cause errors in the measurement of either slideback-peak or peak levels of incoming r-f signals.

3-110. METER ADJUST BOARD.

3-111. The meter adjust board (see figures 5-5 and 5-8) contains the various controls and components required to (a) cancel the contact potential that exists between the plate and cathode of metering detector V908A (see paragraph 3-73), (b) track the output meter over its scale, and (c) monitor the various voltages and currents develpped within the system.

3-112. The low set controls (avg. Low Set control R362, Q.P. Low set control R361, Slideback Low Set control R359, and Peak Low Set control R354) are provided for the development of the small potential equal to but of opposite polarity to the contact potential developed between the plate and cathode of metering detector V908A. These controls are adjusted individually, after the output meter has been zero-set, in conjunction with the OUTPUT switch so that output meter M301 will indicate no deflection when there is no signal coupled to the IF IN jack. The value of these voltages are obtained through the corresponding test points provided, as follows: average test point, TP358; quasi-peak test point, TP357, slideback-peak test point, TP356; peak test point, TP352.

3-113. The deflection of the output meter pointer for a given output of d-c amplifier V1003A is adjustable by means of Meter Gain control R351. Rotation of this screwdriver adjusted control varies the sensitivity of the output meter by inserting series resistance in the meter circuit.

3-114. Scale Tracking control R368 is provided to permit adjusting the grid-to-cathode bias voltage of i-f amplifiers V904 and V905 (see paragraph 3-73) so that the 140/40-mc i-f amplifier operates within its linear region. The bias voltage developed is available for measurement at test point TP359.

3-115. Test Selector switch S351, in conjunction with power monitor meter M302, is provided as a rapid means of monitoring the various operating voltages and currents generated by the FIM-2. This switch enables the operator to monitor the following when the Basic Unit is removed from its dust cover

a. signal calibrator thermistor bridge current

b. first crystal mixer current

c. reflector supply

d. either the first local oscillator anode current (when the FUNCTION SEL switch is in the OPERATE position) or both the first local oscillator and signal calibrator anode currents (when the FUNCTION SEL switch is in the CAL SIG GEN position).

e. anode supply

f. +130-volt supply

g. +105-volt supply

h. -140-volt supply

NOTE:

The Test Selector switch is factory set in the Operate position and should be kept in that position whenever the FIM-2 is being used to perform its normal functions. The switch is primarily an aid for localizing malfunctions to an individual segment of the system.

3-116. LOW-VOLTAGE POWER SUPPLY.

3-117. The low-voltage power supply (see figures 3-9, 5-6, and 5-8) contains the +130- volt, +105-volt, -140-volt, and -6.3-volt regulated supplies, in addition to producing the necessary voltages for the filaments of the vacuum tubes of the crystal-controlled local oscillator, the afc-i-f amplifier, and the anode supply.

3-118. +130-VOLT SUPPLY. The +130-volt supply (see figures 3-9 and 5-6) is a conventional series-type degenerative voltage regulator

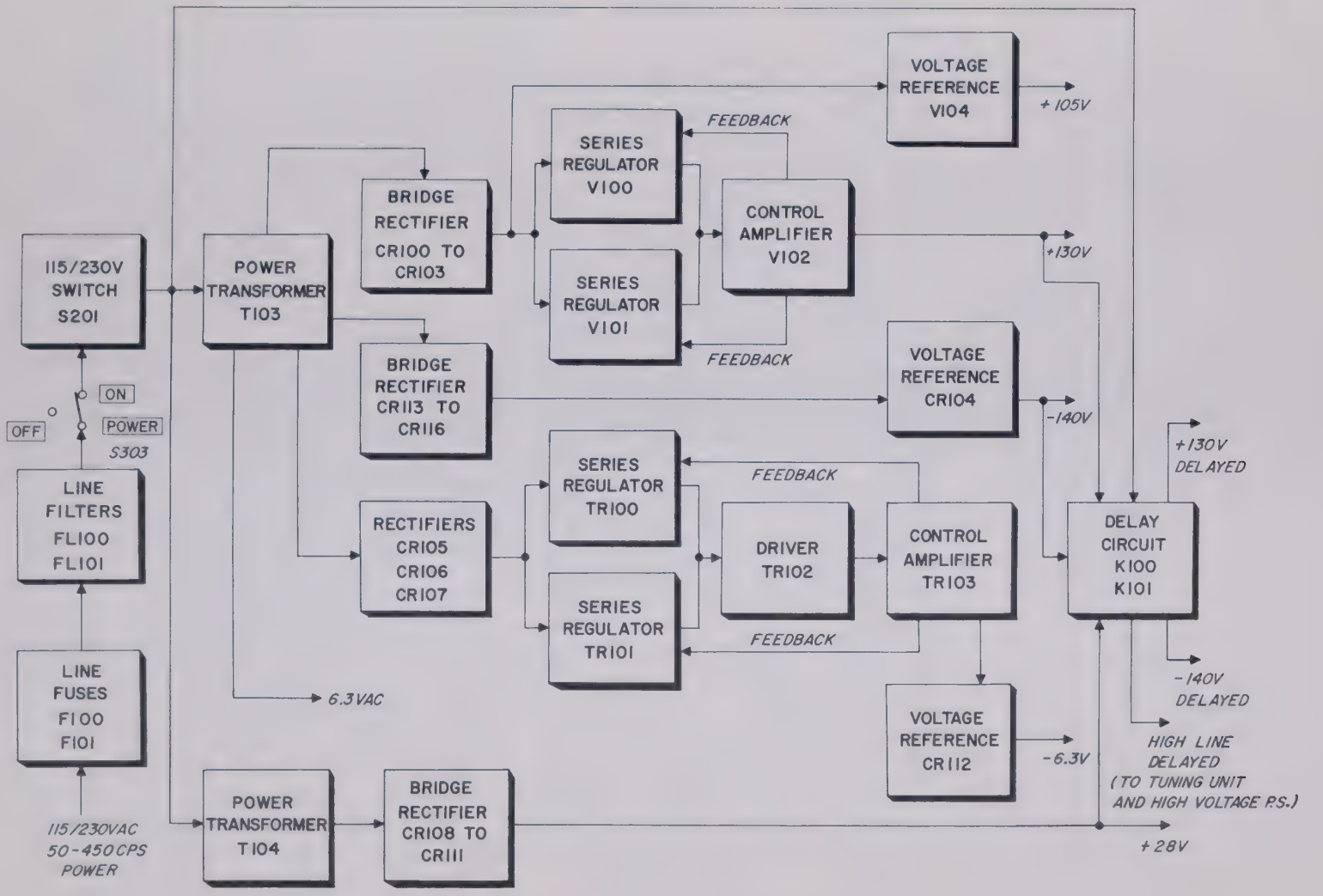


Figure 3-9. Low-Voltage Power Supply, Functional Block Diagram

consisting of series regulators V100 and V101 and control amplifier V102. The bias on the control grid of V102 is adjusted by +130V Adj control R114 to that value necessary to obtain the desired +130-volt output across capacitor C100B. Variations in output voltage due to fluctuations in either line voltage or load current, or both, are amplified by control amplifier V102. The voltage at the plate of V102 controls the bias on the grids of series regulators V100 and V101, causing the output level of the power supply to return to the desired +130 volts.

3-119. -140-VOLT SUPPLY. The -140-volt supply (see figures 3-9 and 5-6) utilizes the characteristics of a zener diode, voltage reference CR104, to obtain the desired output level of -140 volts. In this manner, the zener region of the diode establishes the voltage regulating level (much the same as a gas-tube voltage regulator). The a-c resistance of the diode in the zener region regulates the output for variations in source voltage and/or load current.

3-120. -6.3-VOLT SUPPLY. The -6.3-volt supply (see figures 3-9 and 5-6) which is basically an emitter follower type of degenerative series regulator, consists of control amplifier TR103, driver TR102, and series regulators TR100 and TR101. The base current of TR103 is adjusted by 6.3V Adj control R121 to that value which produces a -6.3-volt output between pin 1 of R121 and ground. Variations in output voltage due to fluctuations in line voltage and/or load current requirements are sensed by reference diode CR116 which, in conjunction with control amplifier TR103 and driver TR102, adjust the current through series regulators TR100 and TR101, causing the output voltage to return to the desired -6.3-volt level.

3-121. +105-VOLT SUPPLY. The +105-volt supply (see figures 3-9 and 5-6) operates from the +130-volt supply, using gas-tube voltage reference V104 to supply an essentially constant voltage equal to the sustaining voltage of +105 volts.

3-122. TIME DELAY CIRCUIT. The 60-second time delay circuit (see figures 3-9 and 5-6) consists of delay relay K100 and hold relay K101. This circuit is provided to delay the application of power to the anode supply (see paragraph 3-125), thereby preventing cold-cathode emission of the tubes in that supply. The time delay circuit also delays the application of the -140-volt and +130-volt supplies to the audio-metering chassis and the high-voltage power supply.

3-123. HIGH-VOLTAGE POWER SUPPLY.

3-124. The high-voltage power supply (see figures 3-10, 5-7, and 5-8) contains the anode supply, a -600-volt supply (which, in conjunction with the anode supply forms the reflector supply), and the afc amplifier.

3-125. ANODE SUPPLY. The anode supply (see figures 3-10 and 5-7) is a conventional degenerative voltage regulator consisting of series regulators V201 and V202 and control amplifier V203. The Tuning Unit in use determines the output voltage of power transformer T201 by applying the delayed power line voltage to the proper terminals of the primary winding. Thus, when the Model FIM-L2 or FIM-S2 Tuning Unit is in use, the anode supply output voltage is equal to -325 volts; when the Model FIM-M2 Tuning Unit is in use, the anode supply output is -1,000 volts; and when the Model FIM-X2 Tuning Unit is in use, the output is -1,250 volts. In this manner, one anode supply functions as three.

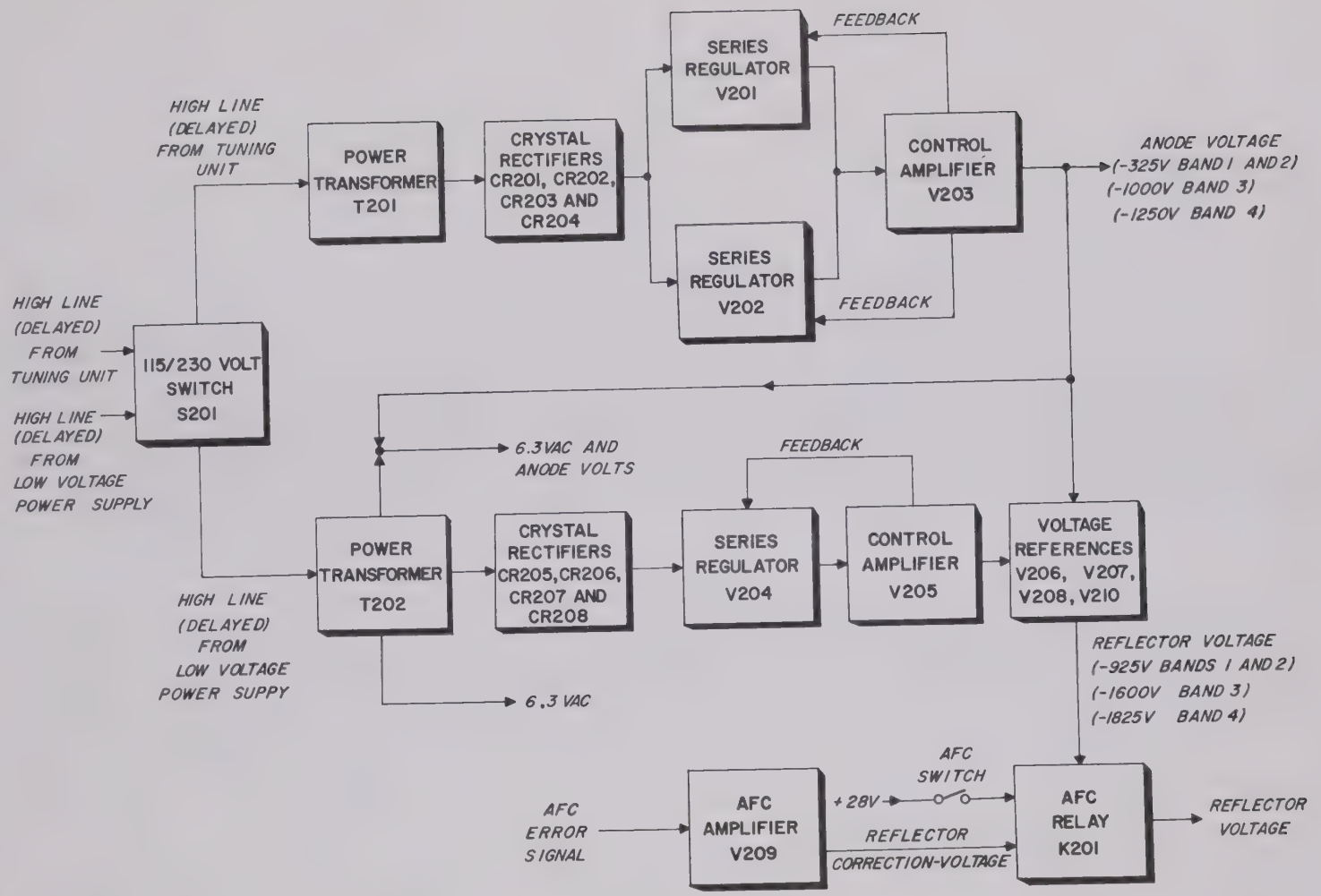

SERIES REGULATOR V201
FEEDBACK
HIGH LINE (DELAYED) FROM TUNING UNIT
POWER TRANSFORMER T201
CRYSTAL RECTIFIERS CR201, CR202, CR203 AND CR204
CONTROL AMPLIFIER V203
ANODE VOLTAGE (-325V BAND 1 AND 2) (-1000V BAND 3) (-1250V BAND 4)
SERIES REGULATOR V202
FEEDBACK
HIGH LINE (DELAYED) FROM TUNING UNIT
115/230 VOLT SWITCH S201
HIGH LINE (DELAYED) FROM LOW VOLTAGE POWER SUPPLY
6.3VAC AND ANODE VOLTS
FEEDBACK
POWER TRANSFORMER T202
CRYSTAL RECTIFIERS CR205, CR206, CR207 AND CR208
SERIES REGULATOR V204
CONTROL AMPLIFIER V205
VOLTAGE REFERENCES V206, V207, V208, V210
HIGH LINE (DELAYED) FROM LOW VOLTAGE POWER SUPPY
6.3 VAC
REFLECTOR VOLTAGE (-925V BANDS 1 AND 2) (-1600V BAND 3) (-1825V BAND 4)
AFC SWITCH
AFC ERROR SIGNAL
AFC AMPLIFIER V209
+28V
REFLECTOR CORRECTION-VOLTAGE
AFC RELAY K201
REFLECTOR VOLTAGE

Figure 3-10. High-Voltage Power Supply, Functional Block Diagram

3-126. The bias on control amplifier V203 is adjusted by one of three controls, depending on which Tuning Unit is in use, as listed below in table 3-3, to such a value that the voltage appearing at the plate of V203 is the bias voltage for the control grids of series regulators V201 and V202 necessary to obtain the desired anode voltage across capacitor C209. Variations in the output of the anode supply due to fluctuations in the line voltage and/or load current requirements are amplified by control amplifier V203. The voltage change appearing at the plate of V203 adjusts the bias on series regulators V201 and V202, returning the output of the supply to the desired value.

TABLE 3-3. ANODE VOLTAGE ADJUSTMENT CONTROLS.

Tuning Unit	Proper Anode Voltage	Anode Voltage Adjust Control
FIM-L2	-325 volts	-325 Adj R216
FIM-S2	-325 volts	-325 Adj R216
FIM-M2	-1,000 volts	-1,000 Adj R214
FIM-X2	-1,250 volts	-1,250 Adj R213

3-127. -600-VOLT SUPPLY (REFLECTOR SUPPLY). The -600-volt (reflector) supply (see figures 3-10 and 5-7) is also a conventional series-type degenerative voltage regulator consisting of series regulator V204, control amplifier V205, and voltage references V206, V207, V208, and V210. The bias on the control grid of V205 is adjusted by Reflector Adj control R325 to that value which causes the voltage appearing across capacitor C210 to be -600 volts. Variations in power line voltage and/or load current requirements are amplified

by control amplifier V205. The voltage change appearing at the plate of V205 causes the grid bias voltage on series regulator V204 to change, correcting the output voltage.

3-128. The -600-volt (reflector) supply is connected in series with the anode supply to provide the reflector voltage required by the reflex klystrons of the Tuning Units. In this manner, both the anode and reflector voltages are automatically selected for the Tuning Unit in use. The proper reflector supply voltages for the Tuning Units are listed below in table 3-4.

TABLE 3-4. PROPER REFLECTOR SUPPLY VOLTAGES

Tuning Unit In Use	Proper Reflector Supply Voltage
Model FIM-L2	-925 volts
Model FIM-S2	-925 volts
Model FIM-M2	-1,600 volts
Model FIM-X2	-1,850 volts

3-129. EXTERNAL MODULATION CIRCUIT.

3-130. The applied square-wave modulating signal coupled to EXT MOD jack J302 is transformer coupled through T301 to the control grid of the signal calibrator. Crystal diode CR302 serves to prevent the grid of the signal calibrator from being driven too positive by the positive portion of the signal appearing at the secondary of T301.

3-131. In Basic Unit serial nos, 291, 294, 297, 298, 307 to 312, 315, 316, 321, and 322, the external modulation signal is applied to the control grid of the signal calibrator only when the FUNCTION SEL switch is set to ZERO SET. The signal then drives the reflex klystron, which is normally biased beyond cutoff, into the conducting region during the interval of the applied pulse.

SECTION IV

MAINTENANCE

4-1. INTRODUCTION.

4-2. This section contains maintenance and alignment procedures for the FIM-2. Included are a list of test equipment required, troubleshooting procedures for localizing the source of system malfunction to an individual subassembly or component, and the alignment procedures required to restore the FIM-2 to its original operating condition after the necessary repairs have been effected.

4-3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for the maintenance and alignment of the FIM-2 system are listed in table 4-1.

4-5. PRELIMINARY INSPECTION.

4-6. Preliminary inspection is a series of visual and aural checks performed on the FIM-2 system while it is in an unenergized state in an effort to correct conditions which might eventually cause system failure. In general, these failures will be caused by the overheating of electrical components, the accumulation of dust, dirt, and/or other foriegn matter on moving parts, and loose connectors and hardware.

4-7. REMOVAL OF FIM-2 FROM DUST COVER. To remove the FIM-2 from its dust cover, proceed as outlined in the following steps.

WARNING:

OPERATION OF THE FIM-2 INVOLVES THE USE OF HIGH VOLTAGES WHICH ARE DANGEROUS TO LIFE. BE SURE TO REMOVE OPERATING POWER FROM THE BASIC UNIT BY DISCONNECTING ELECTRICAL POWER CABLE ASSEMBLY W1201 FROM POWER INPUT RECEPTACLE J100 BEFORE STARTING THE PRELIMINARY INSPECTION PROCEDURE.

TABLE 4-1. TEST EQUIPMENT REQUIRED.

EQUIPMENT, MODEL, AND MANUFACTURER	APPLICATION
Simpson Model 260 Multimeter	Checking voltage and resistance
Measurements Model 80 Standard Signal Generator	Checking i-f circuitry
Marconi Model TF1041B Vacuum Tube Voltmeter	Aligning i-f circuitry
Daven Model 640-50 R-f Attenuation Box	Checking r-f and i-f attenuator insertion loss
Telex Model MR-6 Headset	Tracking output meter scale
Polarad Model MK-1 Klystron Mode Alignment Modulator	Tracking first local oscillator and signal calibrator reflector voltage
Tektronix Model 513 Oscilloscope	Tracking first local oscillator and signal calibrator reflector voltage
FXR Models N410A, H410A, C410A, and W410A Frequency Meters	Tracking first local oscillator and signal calibrator reflector voltage
PRD Models 357, 356A, and 354B Waveguide-to-Coax Adapters (2 each)	Tracking first local oscillator and signal calibrator reflector voltage
Dage Model 1021H Crystal Detector	Tracking first local oscillator and signal calibrator reflector voltage
Polarad Models MSG-1, MSG-2A, and PMX Microwave Signal Generators	Aligning preselector
Polarad Model P-3 Microwave Power Meter	Checking signal calibrator power output
Polarad Model TM-1 Thermistor Mount	Checking signal calibrator power output

a. Turn each of the six captive-lock fasterners (four located at the rear of the dust cover and two located on the sides of the dust cover) one-quarter turn counterclockwise with a screwdriver.

WARNING:

THE FIM-2 (WITH A PLUG-IN TUNING UNIT INSTALLED) WEIGHS APPROXIMATELY 200 POUNDS. TWO PEOPLE SHOULD BE EMPLOYED AT ALL TIMES WHEN LIFTING, TRANSPORTING, OR PACKING THE EQUIPMENT.

b. With two men working on the FIM-2 (one on each side of the equipment), grasp the two Tuning Unit front panel handles and carefully slide the Basic Unit and Tuning Unit from the dust cover.

4-8. REMOVAL OF TUNING UNIT FROM BASIC UNIT. To remove the Tuning Unit from the Basic Unit, proceed as outlined in the following steps.

a. Turn each of the four captive-lock fasteners (one located at each corner of the Tuning Unit front panel) one-quarter turn counterclockwise with a screwdriver.

CAUTION:

DO NOT REMOVE A TUNING UNIT FROM (OR INSERT A TUNING UNIT INTO) THE BASIC UNIT WHEN THE FREQUENCY IN KILOMEGACYCLES DIAL INDICATES A FREQUENCY OTHER THAN THE HIGH END OF THE BAND.

b. Note the FREQUENCY IN KILOMEGACYCLES dial indication. If an indication other than the high end of the band is obtained, rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication at the high end of the band.

c. Grasp the two Tuning Unit front panel handles and carefully slide the Tuning Unit from the Basic Unit.

4-9. With the equipment now visible and accessible, proceed as outlined in table 4-2 in an effort toward finding evidence of conditions which might cause system failure.

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE.

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Cable assemblies (including electrical power cable, r-f cables, i-f cables, and video cables)	Kinks, cuts, deterioration, and fraying of insulation	Replace defective cable assembly	
	Loose connectors	Resolder connector or replace cable assembly	
	Dirt, oil, grease, and corrosion	Clean with a cloth moistened with cleaning solvent	
Harnessed cable assemblies	Loose connectors	Resolder connector	
	Deteriorated and/or frayed leads	Replace lead and relace cable	
	Defective or poor lacing	Relace cable	
Knobs, screws, connectors, and handles	Looseness	Tighten	Tighten carefully. Screws tightened beyond the pressure for which they were designed can be damaged or broken

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Front panel switches	Inability to change position	Replace and rewire switch	
	Looseness	Tighten mounting hardware	
	Bent or broken contacts	Straighten contacts with tweezer or replace and rewire switch	
Fuses	Dirty fuse clips	Clean with a cloth	
Frame assemblies and Basic Unit subassemblies	Dirt and rust	Remove with brush or low-pressure air	
	Oil and grease	Remove with a cloth moistened with cleaning solvent	
Mounting screws and clamps	Looseness	Tighten	Do NOT touch slotted shafts of variable resistors
Wiring	Loose wires	Resolder, recable, and reclamp	
	Frayed, worn, or missing insulation	Replace wire	

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Solder joints	Corroded joints	Clean and resolder	
Terminal board assemblies	Loose mounting	Tighten mounting screws and nuts	
Resistors	Crackes, chips, discoloration, blistering, and other signs of overheating	Replace resistor	Overheating components are a sign of equipment malfunction. Refer to proper troubleshooting paragraph to localize malfunction
Capacitors	Leaks, bulges, and other signs of deterioration	Replace capacitor	See above
Front panel meters	Bent pointer	Replace meter	
	Cracked or broken meter cover	Replace cover	
Vacuum tubes (except for reflex klystrons)	Poor seating	Press tubes firmly into sockets	Never work on tubes immediately after shutting off power. Do not jiggle or partially remove tubes from sockets. Such movements tend to weaken tube pins and spread socket connectors. DO NOT CHECK REFLEX KLYSTRONS

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	PRECAUTIONS
Tube shields (except for reflex klystron protective shield)	Poor seating	Press into position	
	Missing shields	Replace	
Tube sockets	Cracked or chipped sockets	Replace and rewire	
	Looseness	Tighten mounting screws	
FREQUENCY IN KILOMEGACYCLES dial window	Cracked or broken	Replace (A temporary repair may be effected with transparent tape)	
-DBM MICROVOLTS dial window	Cracked or broken	See above	
Precision mechanical drive system	Catching or jamming when TUNING control is rotated	Remove dust, dirt, and any foreign matter	Release the TUNING control Lock lever by turning it counterclockwise CAUTION: DO NOT MOVE THE PRECISION MECHANICAL DRIVE SYSTEM BY ANY MEANS OTHER THAN THE TUNING CONTROL. DO NOT INTERFERE IN ANY WAY WITH THE OPERATION OF THE GEARS WHILE THE TUNING CONTROL
	Broken gears	Replace	

TABLE 4-2. PRELIMINARY INSPECTION PROCEDURE (cont'd).

WHAT TO INSPECT	DEFECTS TO LOOK FOR	REMEDIES	RRECAUTIONS
Precision mechanical drive system (cont'd)			IS BEING ROTATED. NEVER USE FORCE.
Thermistor probe and output attenuator probe drive system	Catching or jamming when either SIGNAL CALIBRATOR POWER SET or SIGNAL CALIBRATOR OUTPUT ATTENUATOR control is rotated	Remove dirt, dust, and any foreign matter	CAUTION: DO NOT MOVE THE DRIVE SYSTEM BY ANY MEANS OTHER THAN THE FRONT PANEL CONTROLS. DO NOT INTERFERE WITH THE OPERATION OF THE GEARS WHEN THE CONTROLS ARE BEING ROTATED. NEVER USE FORCE.
	Broken gears	Replace	

4-10. POWER SUPPLY CHECK.

4-11. Improper operation of the FIM-2 most likely will be caused by a malfunction of the power supplies located within the Basic Unit. The step-by-step troubleshooting procedure for localizing the malfunction to an individual section of the power supplies is listed in table 4-3. Further localization to an individual circuit component can be accomplished through the voltage and resistance measurements supplied in tables 4-4 and 4-5, the component location diagrams supplied in figures 4-1 through 4-8, and the schematic diagrams of the low-voltage and high-voltage power supplies supplied in figures 5-6 and 5-7, respectively. Make sure that all connectors are firmly secured to their mating receptacles before applying operating power to the FIM-2.

NOTE

When setting the output levels of the +130 volt supply, reflector supply, and anode supply, maintain the line voltage applied to the FIM-2 at 115 volts rms through the use of a Variac.

Set the output level of the +130 volt supply at exactly +130 volts through the use of a John Fluke Model 801 Differential voltmeter.

Set the output levels of the anode and reflector supplies at their exact values, which are dependent upon the tuning unit in use, through the use of the John Fluke Model 801 Differential Voltmeter and Model 80B5 Volt Box.

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
1	Visual and aural	None	Patch cable assembly W1206 connected between J1150 of Basic Unit and P1150 of Tuning Unit. POWER switch set to ON.	POWER pilot lamp immediately lights; blowers operate.	Proceed to step 5.	Check fuses F100 and F101. Check POWER pilot lamp assembly. Proceed to step 2.
2	Power source	A-c voltmeter	Measure source voltage.	115 volts rms.	Proceed to step 3.	Trouble is in a-c power source.
3	Electrical power cable assembly W1201	Ohmmeter	W1201 disconnected from both power source and Basic Unit Power Input receptacle J100.	Continuity from end to end for each lead. Infinite resistance between leads at either end.	Proceed to step 4.	Electrical power cable assembly W1201 defective: repair of replace as necessary.
4	Power Input receptacle J100	Ohmmeter	W1201 disconnected from J100. Measure resistance between pins of J100.	1 ohm.	Connect W1201 to J100.	Trouble lies in Power Input receptacle J100, line filters FL100 and/or FL101, POWER switch S303, 115/230V switch S201, blower B101, or the primaries of power transformers T103 and/or T104.
5	Visual	None	POWER switch set to ON.	KLY pilot lamp lights approximately 60 seconds after operating power is applied.	Proceed to step 9.	Check KLY pilot light assembly. Check fuse F104. Proceed to step 6.
6	Terminal board assembly TB102	D-c voltmeter	Voltmeter connected between junction of CR108 and CR111 and junction of CR109 and CR110.	+28 volts.	Proceed to step 7.	+28-volt supply defective.
7	Delay relay K100	D-c voltmeter	Voltmeter connected between pins 1 and 6 of K100.	0 volts.	Proceed to step 8.	Delay relay K100 defective: replace.
8	Hold relay K101	D-c voltmeter	Voltmeter connected between pins 2 and 9 of K101.	0 volts	-----	Hold relay K101 defective; replace.
9	Visual	None	OUTPUT switch set to ZERO SET. Adjust output meter ZERO SET control to obtain an output meter pointer deflection corresponding to zero-set.	Output meter pointer can be zero-set.	Proceed to step 13.	Check output meter ZERO SET control R310. Proceed to step 10.

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
10	Visual	None	Set Test Selector switch S351 to -140 V.	Power monitor meter pointer deflects to an indication within the green region of the scale.	Proceed to step 11.	-140-volt supply defective.
11	Meter Sensitivity control R351	Ohmmeter	P351 disconnected from J108. Ohmmeter connected between pins A and B of P351.	Ohmmeter reads approximately 2.3K ohms	Reconnect P351 to J108. Proceed to step 12.	Meter Sensitivity control R351 defective: replace.
12	Output Meter M301	None	Check Meter.	---	---	Output Meter M301 defective replace.
13	Visual	None	FUNCTION SEL switch set to ZERO set. Adjust power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.	Power monitor meter can be zero-set.	Proceed to step 15.	Check power monitor meter ZERO SET control R312. Proceed to step 14.
14	Visual	None	Set Test Selector switch S351 to +105V.	Power monitor meter pointer deflects to an indication within the green region of the scale.	Check thermistor bridge circuitry (refer to paragraph 4-69).	+105-volt supply defective.
15	Visual	None	Set Test Selector switch S351 to Xtal Cur. Set FUNCTION SEL switch to OPERATE. Rotate TUNING control throughout the band	Power monitor meter pointer deflects smoothly (except atmpoint of mode switching for the Models FIM-S2 and FIM-M2 Tuning Units) as the TUNING control is rotated.	Proceed to step 16.	First crystal mixer defective (refer to paragraph 4-59).
16	Visual	None	Set Test Selector switch S351 to Refl.	Power monitor meter pointer Deflects to an indication within the green region of the scale.	Proceed to step 17.	Adjust Reft. Adjust control to obtain a power monitor pointer deflection within the green region of the scale. NOTE: Adjustment of Refl Adjust control R235 to obtain indication of proper reflector voltage will necessitate retracking of first local oscillator and signal calibrator reflector voltage (refer to paragraph 4-70 and 4-88, respectively)

TABLE 4-3. POWER SUPPLY CHECK PROCEDURE (CONT'D)

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION IS NORMAL	IF INDICATION IS ABNORMAL
16 (Cont)						and retracking of the preselector (refer to paragraph 4-92).
17	Visual	None	Test Selector switch set to Anode V.	Power monitor meter pointer deflects to indication within green region of scale.	Proceed to step 18.	Adjust proper anode voltage adjust control to obtain desired indication. If this cannot be obtained, anode supply is defective.
18	Visual	None	Test Selector switch set to Anode MA. FUNCTION SEL switch set to OPERATE.	Power monitor meter pointer deflects to indication of +1 (for FIM-L2 and FIM-S2) or -1 (for FIM-M2 and FIM-X2).	Proceed to step 19.	Adjust proper L.O. Bias control to obtain desired indication. If this cannot be obtained check first local oscillator grid bias resistors.
19	Visual	None	Test Selector switch set to Anode Ma. FUNCTION SEL switch set to CAL SIG GEN.	Same as above.	Proceed to step 20.	Adjust proper S.C. Bias control to obtain desired deflection. If this cannot be obtained check signal calibrator grid bias resistors.
20	Visual	None	Test Selector switch set to +130V	Power monitor meter pointer deflects to indication within green region of scale.	Basic Unit power supplies operating properly. Proceed to paragraph 4-12.	Adjust +130V Adj control R114 to obtain desired indication. If this cannot be obtained +130 volt supply defective.

TABLE 4-4. LOW-VOLTAGE POWER SUPPLY, VOLTAGE AND RESISTANCE MEASUREMENTS

Socket	Tube Type	Pin Numbers								
		1	2	3	4	5	6	7	8	
XV100	6AS7	+87	+235	+125	+87	+235	+125	FIL	FIL	Volts
		550K	8.5K	8.2K	550K	8.5K	8K	Inf	Inf	Ohms
XV101	6AS7	+87	+235	+125	+87	+235	+125	FIL	FIL	Volts
		550K	8.5K	8.2K	550K	8.5K	8K	Inf	Inf	Ohms
XV102	6AU6	-1	0	FIL	FIL	+75	+33	0		Volts
		550K	0	Inf	Inf	550K	30K	0		Ohms
XV104	0B2	+105	0	NC	0	+105	NC	0		Volts
		Inf	0		0	Inf		0		Ohms

Socket	Transistor Type	Emitter	Collector	Base	
XTR100	2N277	-7.5	-11	-8	Volts
		0.5	9	10	Ohms
XTR101	2N277	-7.5	-11	-8	Volts
		0.5	9	10	Ohms
XTR102	2N456	-8	-11	-8.2	Volts
		10	9	15	Ohms
XTR103	2N207	-6	-8.2	-6.2	Volts
		14	15	0.8	Ohms

NOTES:
1. FIL = 6.3 VAC between pins so marked.
2. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
3. Resistance readings taken with power cable removed.

TABLE 4-5. HIGH-VOLTAGE POWER SUPPLY, VOLTAGE AND RESISTANCE MEASUREMENTS.

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV201 [4]	807	Fil	+125	-5.2	+2.6	Fil	+530 [8]				Volts
		Inf	280K	500K	50	Inf	Inf				Ohms
XV201 [5]	807	Fil	+125	-9	+1.3	Fil	+575 [8]				Volts
		Inf	280K	500K	50	Inf	Inf				Ohms
XV201 [6]	807	Fil	+125	-5.8	+2.4	Fil	+520 [8]				Volts
		Inf	320K	600K	50	Inf	Inf				Ohms
XV202 [4]	807	Fil	+125	-5.2	+2.6	Fil	+530 [8]				Volts
		Inf	280K	500K	50	Inf	Inf				Ohms
XV202 [5]	807	Fil	+125	-9	+1.3	Fil	+575 [8]				Volts
		Inf	280K	500K	50	Inf	Inf				Ohms
XV202 [6]	807	Fil	+125	-5.8	+2.4	Fil	+520 [8]				Volts
		Inf	320K	600K	55	Inf	Inf				Ohms
XV203 [4]	12AX7	-5.2	-57	-56		Fil	-56	-140	-138	Fil	Volts'
		500K	250K	22K		Inf	250K	600K	18K	Inf	Ohms
XV203 [5]	12AX7	-9.5	-57	-56		Fil	-56	-140	-138	Fil	Volts
		500K	250K	22K		Inf	250K	520K	18K	Inf	Ohms
XV203 [6]	12AX7	-5.7	-57	-53		Fil	-53	-140	-138	Fil	Volts
		600K	260K	22K		Inf	260K	550K	18K	Inf	Ohms
XV204 [4]	6AR6	-385		-118		-118	Fil	-385	Fil		Volts
		35K	NC	Inf	NC	Inf	Inf	550K	Inf		Ohms
XV204 [5]	6AR6	-1000		-560		-560	Fil	-1050	Fil		Volts
		72K	NC	Inf	NC	Inf	Inf	560K	Inf		Ohms
XV204 [6]	6AR6	-1250		-820		-820	Fil	-1300	Fil		Volts
		90K	NC	Inf	NC	Inf	Inf	680K	Inf		Ohms
XV205 [4]	12AX7	-385	-460	-460		Fil	-460	-610	-610	Fil	Volts
		550K	175K	Inf		Inf	175K	600K	100K	Inf	Ohms
XV205 [5]	12AX7	-1050	-1100	-1100		Fil	-1100	-1250	-1250	Fil	Volts
		560K	210K	Inf		Inf	210K	620K	135K	Inf	Ohms
XV205 [6]	12AX7	-1300	-1380	-1380		Fil	-1380	-1520	-1520	Fil	Volts
		680K	240K	Inf		Inf	240K	750K	160K	Inf	Ohms
XV206 [4]	OA2	-320	-460		-460	-320		-460			Volts
		35K	Inf	NC	Inf	35K	NC	Inf			Ohms
XV206 [5]	OA2	-980	-1100		-1100	-980		-1100			Volts
		72K	Inf	NC	Inf	72K	NC	Inf			Ohms
XV206 [6]	OA2	-1250	-1380		-1380	-1250		-1350			Volts
		90K	Inf	NC	Inf	90K	NC	Inf			Ohms
XV207 [4]	OB2	-910	-1050		-1050	-910		-1050			Volts
		80K	Inf	NC	Inf	80K	NC	Inf			Ohms
XV207 [5]	OB2	-1550	-1700		-1700	-1550		-1700			Volts
		110K	Inf	NC	Inf	110K	NC	Inf			Ohms
XV207 [6]	OB2	-1800	-1960		-1960	-1800		-1960			Volts
		135K	Inf	NC	Inf	135K	NC	Inf			Ohms
XV208 [4]	OA2	-1050	-1150		-1150	-1050		-1150			Volts
		Inf	Inf	NC	Inf	Inf	NC	Inf			Ohms
XV208 [5]	OA2	-1700	-1780		-1780	-1700		-1780			Volts
		Inf	Inf	NC	Inf	Inf	NC	Inf			Ohms
XV208 [6]	OA2	-1960	-2050		-2050	-1960		-2050			Volts
		Inf	Inf	NC	Inf	Inf	NC	Inf			Ohms
XV209 [4]	6AH6	0	0	Fil	Fil 9	0	-910	Fil 9			Volts
		Inf	Inf	Inf	Inf	Inf	80K	Inf			Ohms
XV209 [5]	6AH6	0	0	Fil	Fil 9	0	-1550	Fil 9			Volts
		Inf	Inf	Inf	Inf	Inf	110K	Inf			Ohms
XV209 [6]	6AH6	0	0	Fil	Fil 9	0	-1800	Fil 9			Volts
		Inf	Inf	Inf	Inf	Inf	135K	Inf			Ohms
XV210 [4]	OA2	-460	-610		-610	-460		-610			Volts
		Inf	100K	NC	100K	Inf	NC	100K			Ohms
XV210 [5]	OA2	-1100	-1250		-1250	-1100		-1250			Volts
		Inf	135K	NC	135K	Inf	NC	135K			Ohms
XV210 [6]	OA2	-1380	-1520		-1520	-1380		-1520			Volts
		Inf	160K	NC	160K	Inf	NC	160K			Ohms

NOTES:

1. FIL = 6.3 VAC between pins so marked
2. Voltage readings taken with 20,000 ohm/volt VOM between pin and ground.
3. Resistance readings taken with power cable removed.
4. FIM-L2 or FIM-S2 Tuning Unit in use.
5. FIM-M2 Tuning Unit in use.
6. FIM-X2 Tuning Unit in use.
7. AFC switch set to OUT.
8. Measured between tube cap and ground
9. Pin 4 shorted to pin 7.

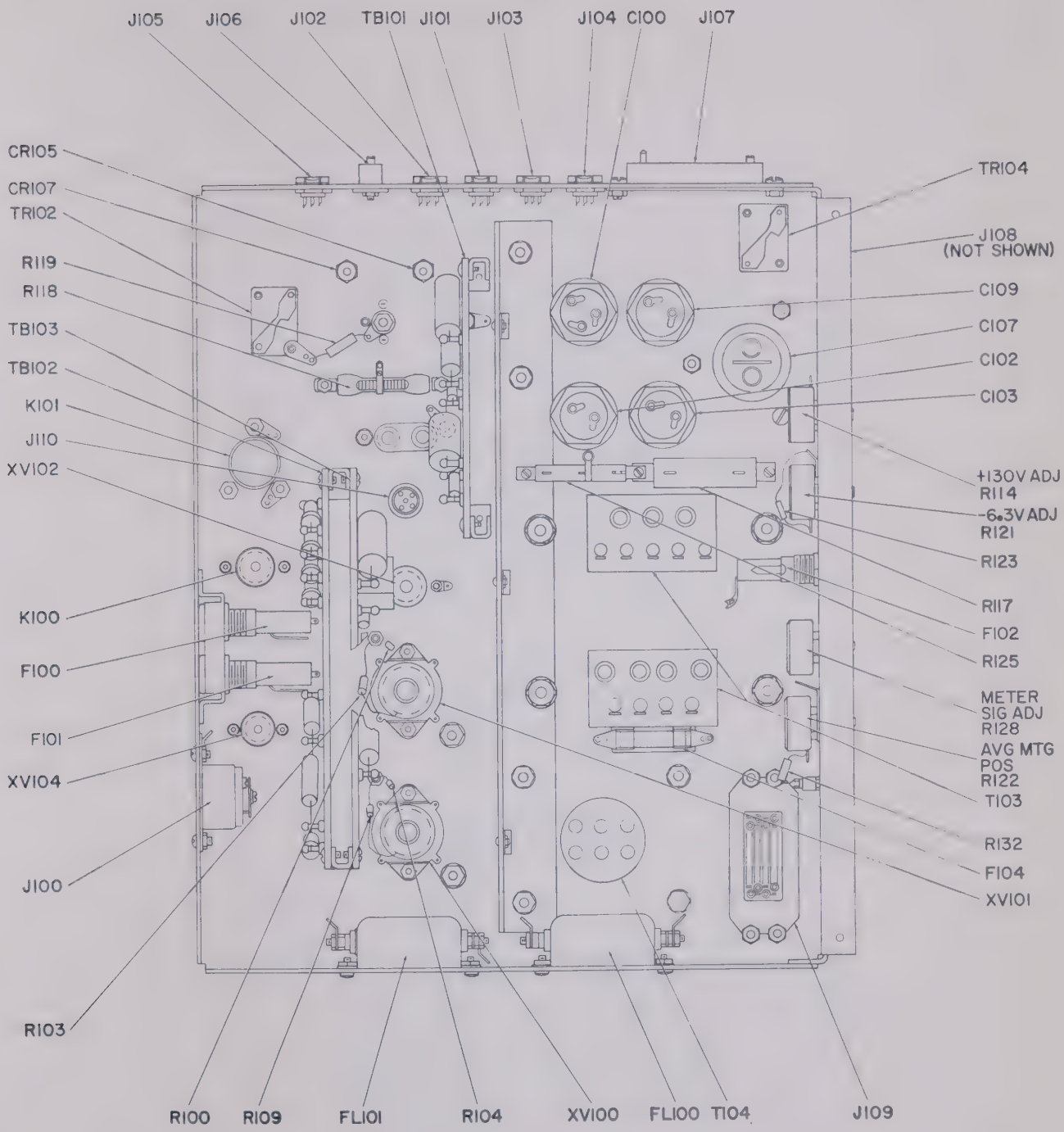


Figure 4-1. Low-Voltage Power Supply, Component Location Diagram

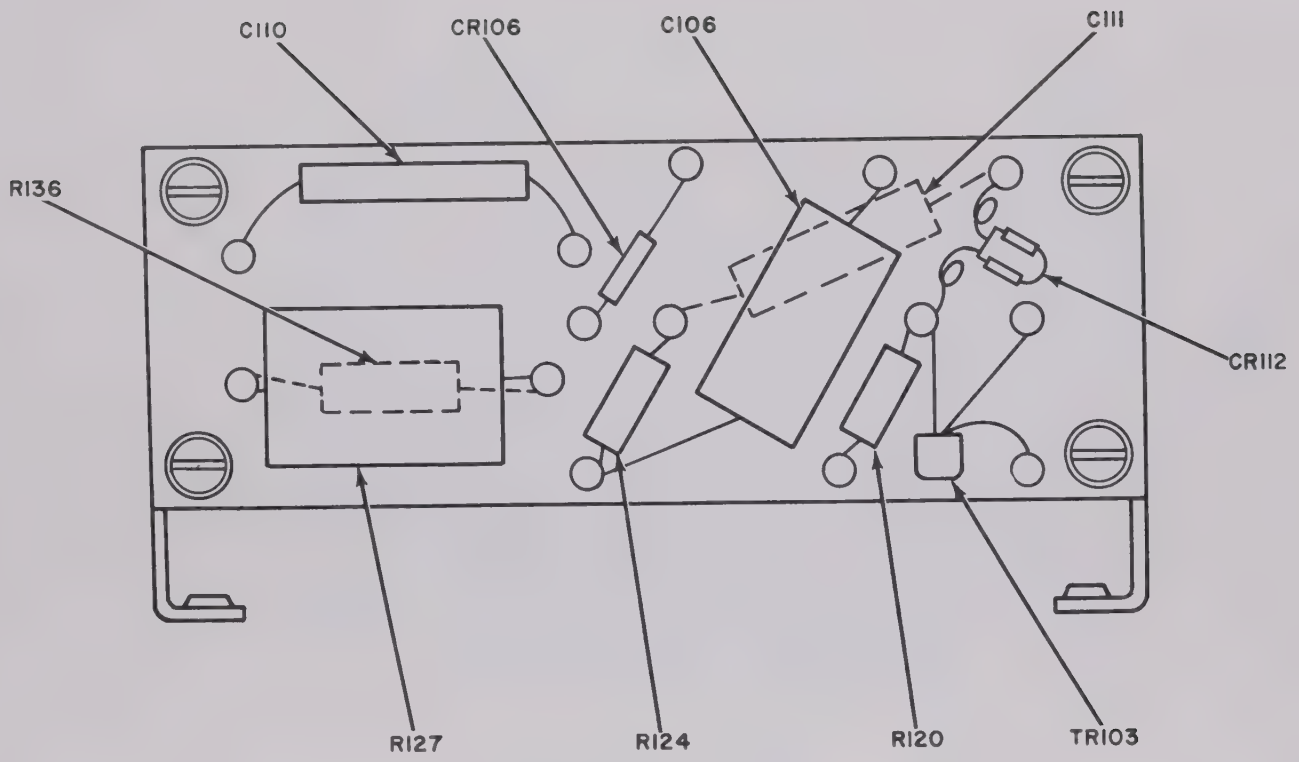


Figure 4-2. Terminal Board Assembly TB101, Component Location Diagram

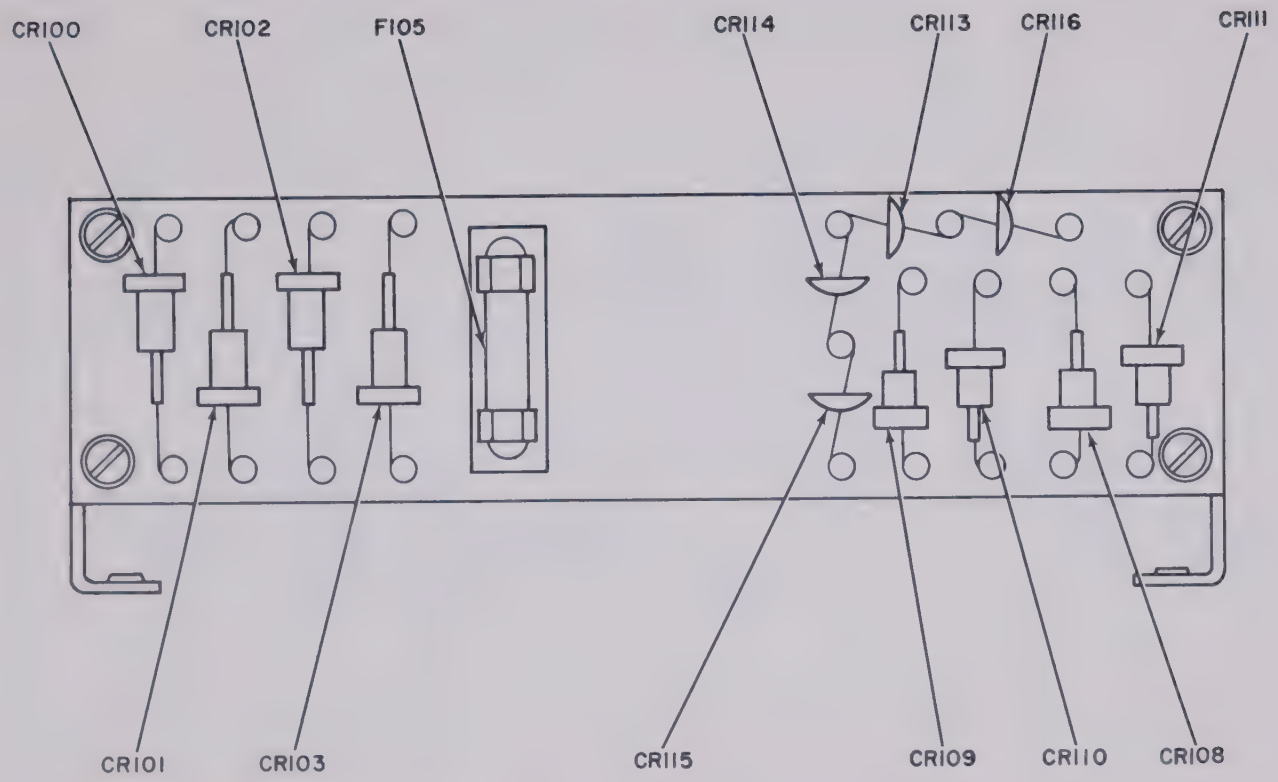


Figure 4-3. Terminal Board Assembly TB102, Component Location Diagram

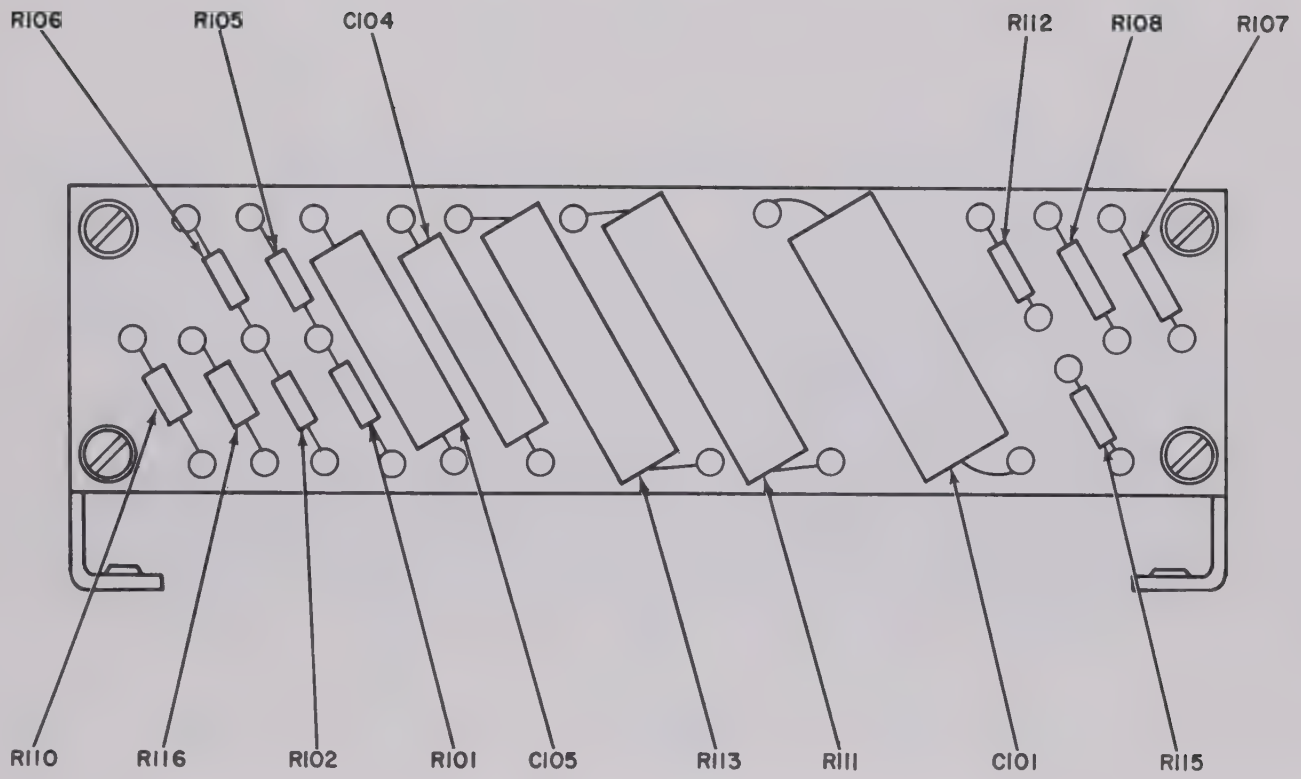


Figure 4-4. Terminal Board Assembly TB103, Component Location Diagram

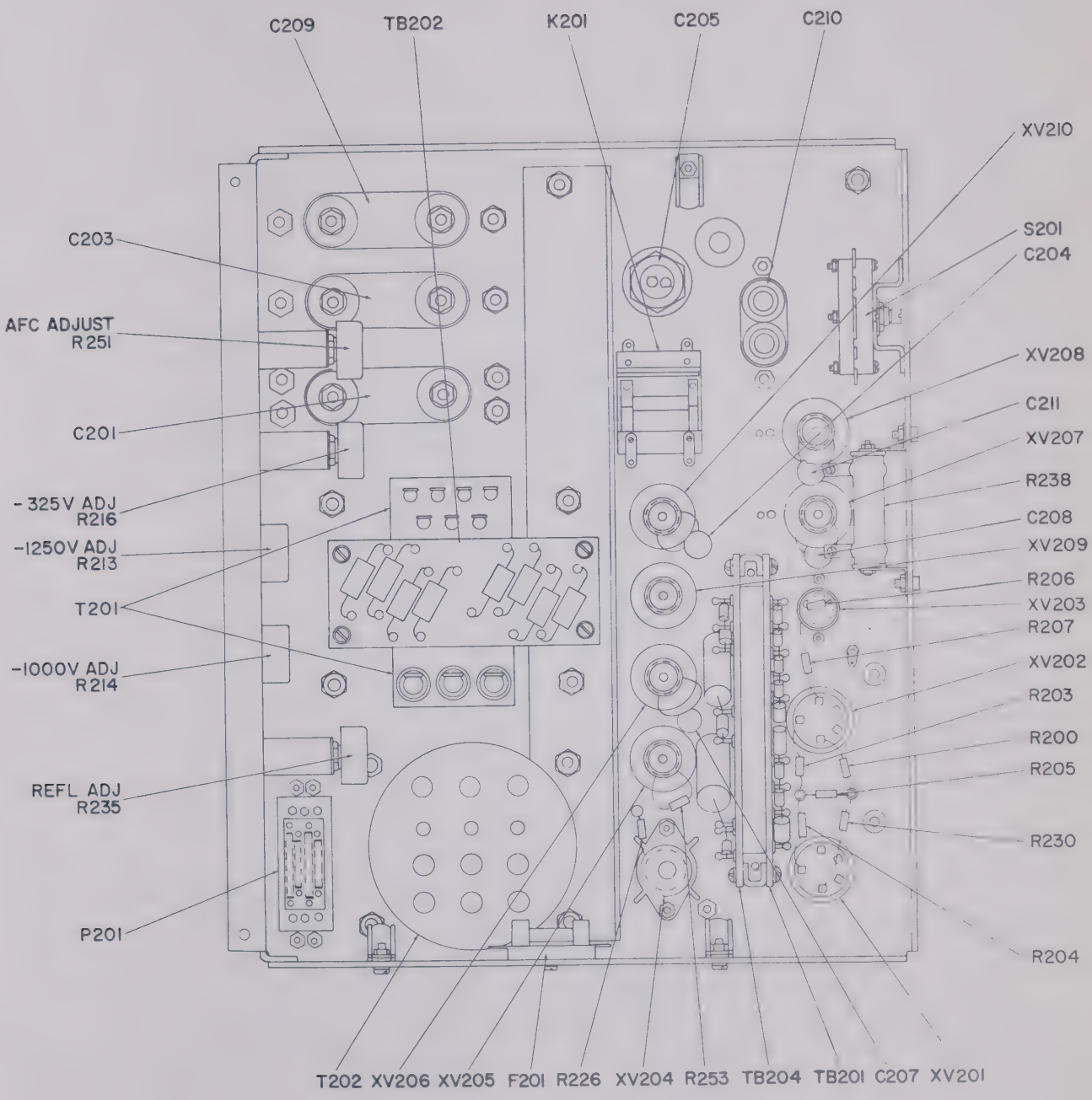


Figure 4-5. High-Voltage Power Supply, Component Location Diagram

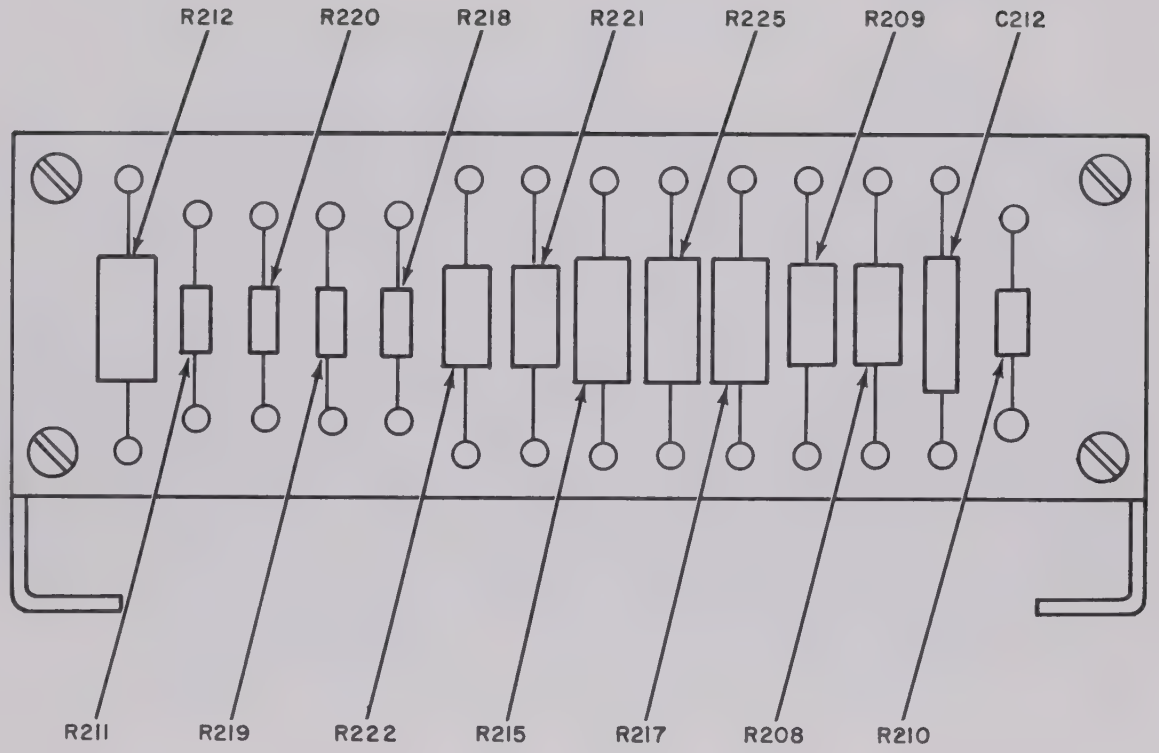


Figure 4-6. Terminal Board Assembly TB201, Component Location Diagram

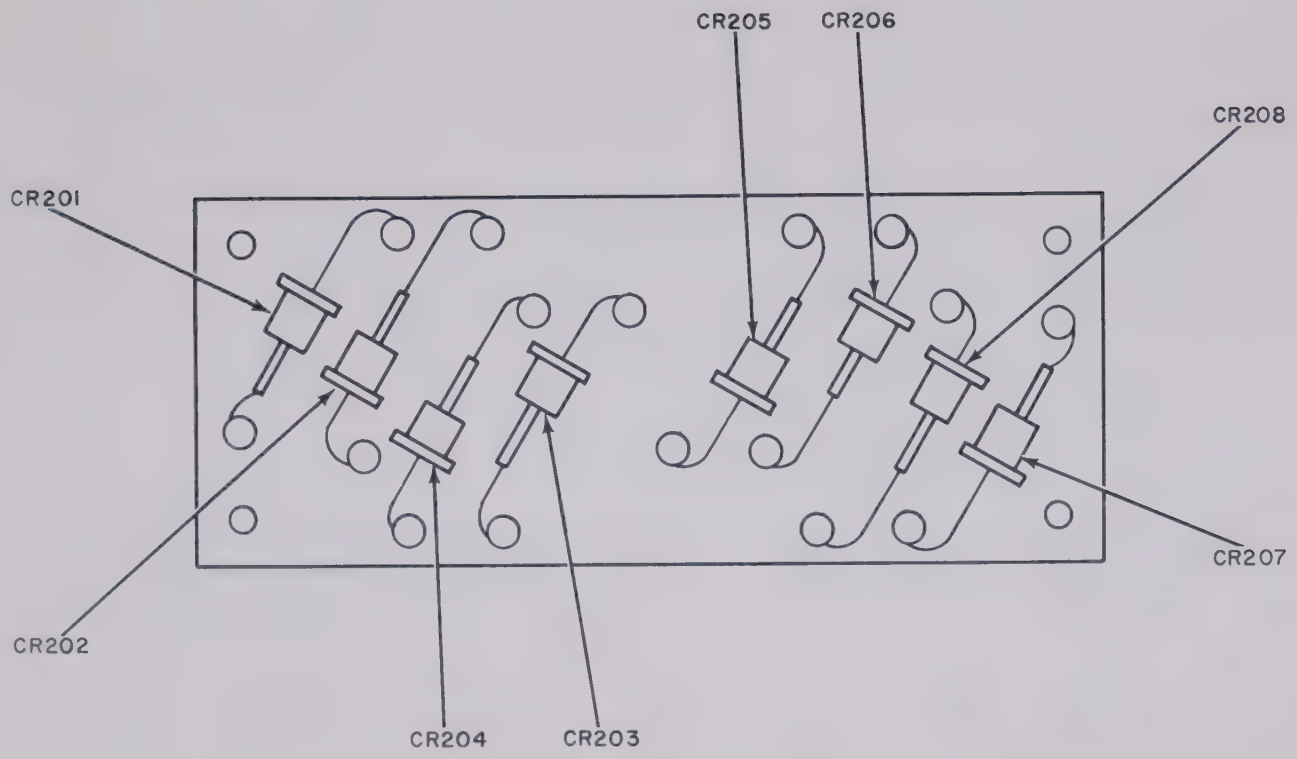


Figure 4-7. Terminal Board Assembly TB202, Component Location Diagram

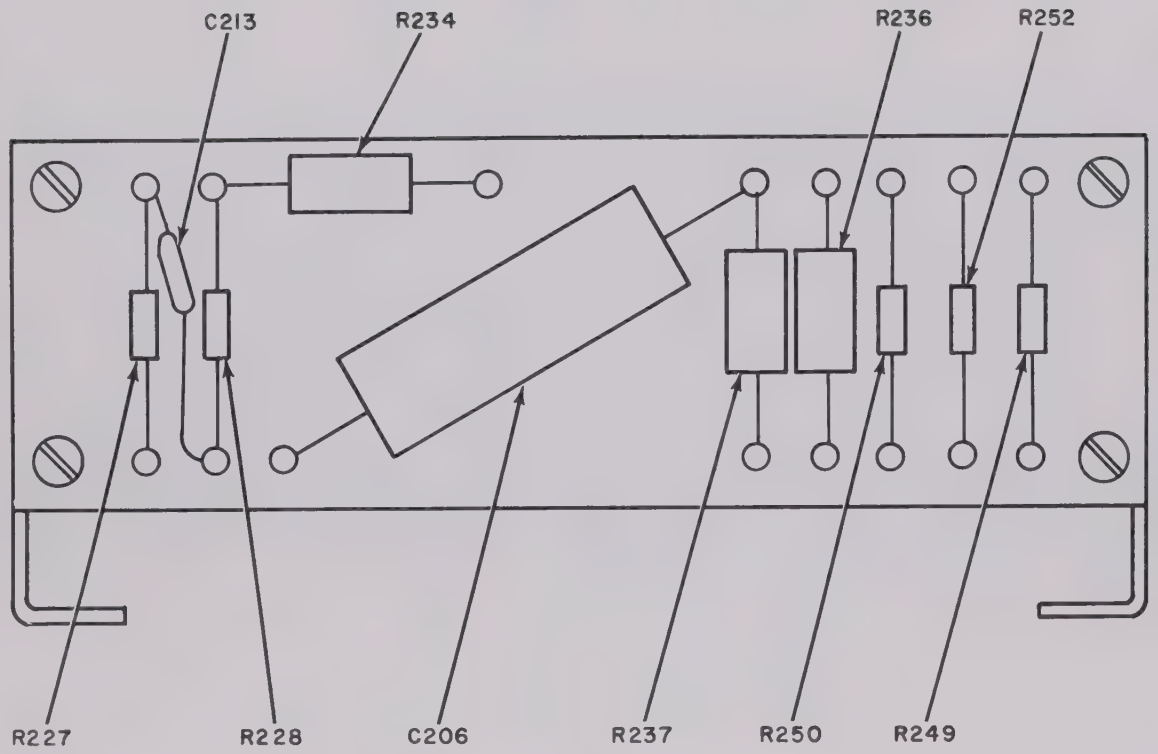


Figure 4-8. Terminal Board Assembly TB204, Component Location Diagram

4-12. LOCALIZING TROUBLE TO EITHER R-F OR I-F CIRCUITRY.

4-13. After the power supplies have been checked out and are operating properly (see paragraph 4-10), proceed as outlined in the following steps to determine if the cause of system malfunction is localized to the r-f or i-f circuitry.

a. Set the OUTPUT switch to ZERO SET.

b. Adjust the output meter ZERO SET control to zero-set the output meter.

c. Set the OUTPUT switch to AVERAGE.

d. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

e. Rotate the IF GAIN control fully clockwise.

f. Note the output meter pointer deflection on the RF UV scale. It should deflect to an indication of at least 30.

g. Connect a calibrated signal generator, tuned to 260 mc and adjusted to an output level of 3 microvolts, to the IF IN jack, as shown in figure 4-9.

h. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale.

i. Adjust the output level of the calibrated signal generator to 300 microvolts. Note the output meter pointer deflection. It should deflect to an indication of 1000 $^{+60}_{-56}$ on the RF UV scale.

j. If the output meter pointer deflections of steps f and i, above, cannot be obtained, the trouble has been localized to the i-f circuitry (refer to paragraph 4-14). If these indications are obtained, the trouble has been localized to the r-f circuitry (refer to paragraph 4-57).

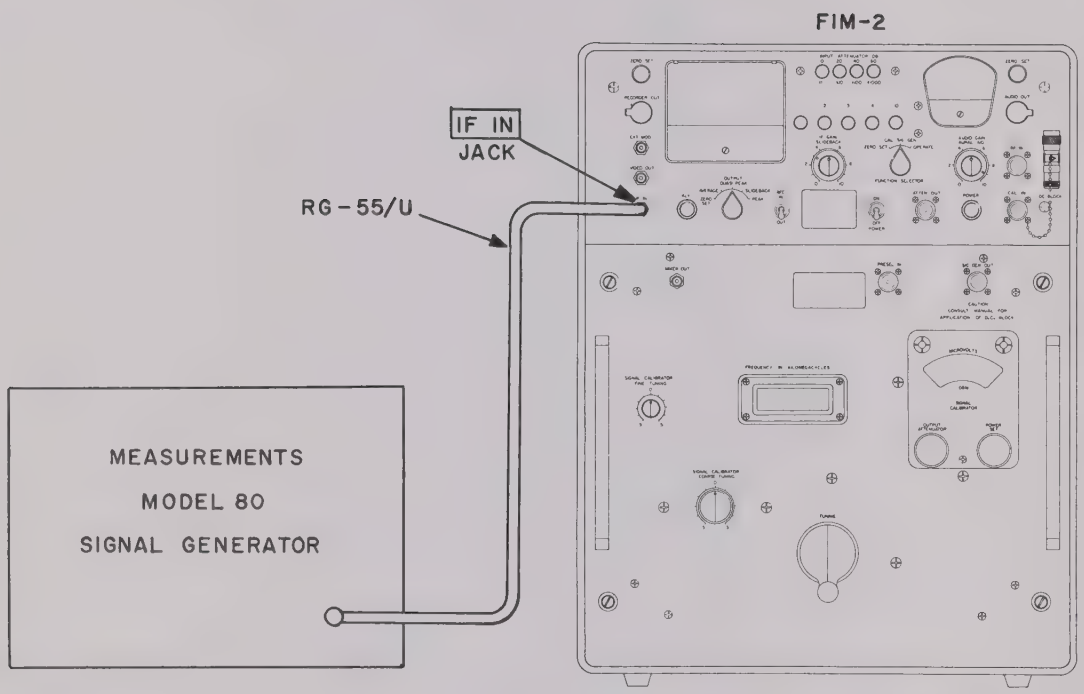


Figure 4-9. Localizing Trouble to Either R-f or I-f Circuitry, Equipment Set Up

4-14. LOCALIZING I-F TROUBLE TO AN INDIVIDUAL SUBASSEMBLY.

4-15. If the result of paragraph 4-12 indicated that the trouble lies in the i-f circuitry, proceed as outlined in table 4-6 to localize the i-f trouble to an individual subassembly within the Basic Unit i-f circuitry. Figures 4-10 and 4-11 will be of aid in locating the Basic Unit subassemblies and cable assemblies.

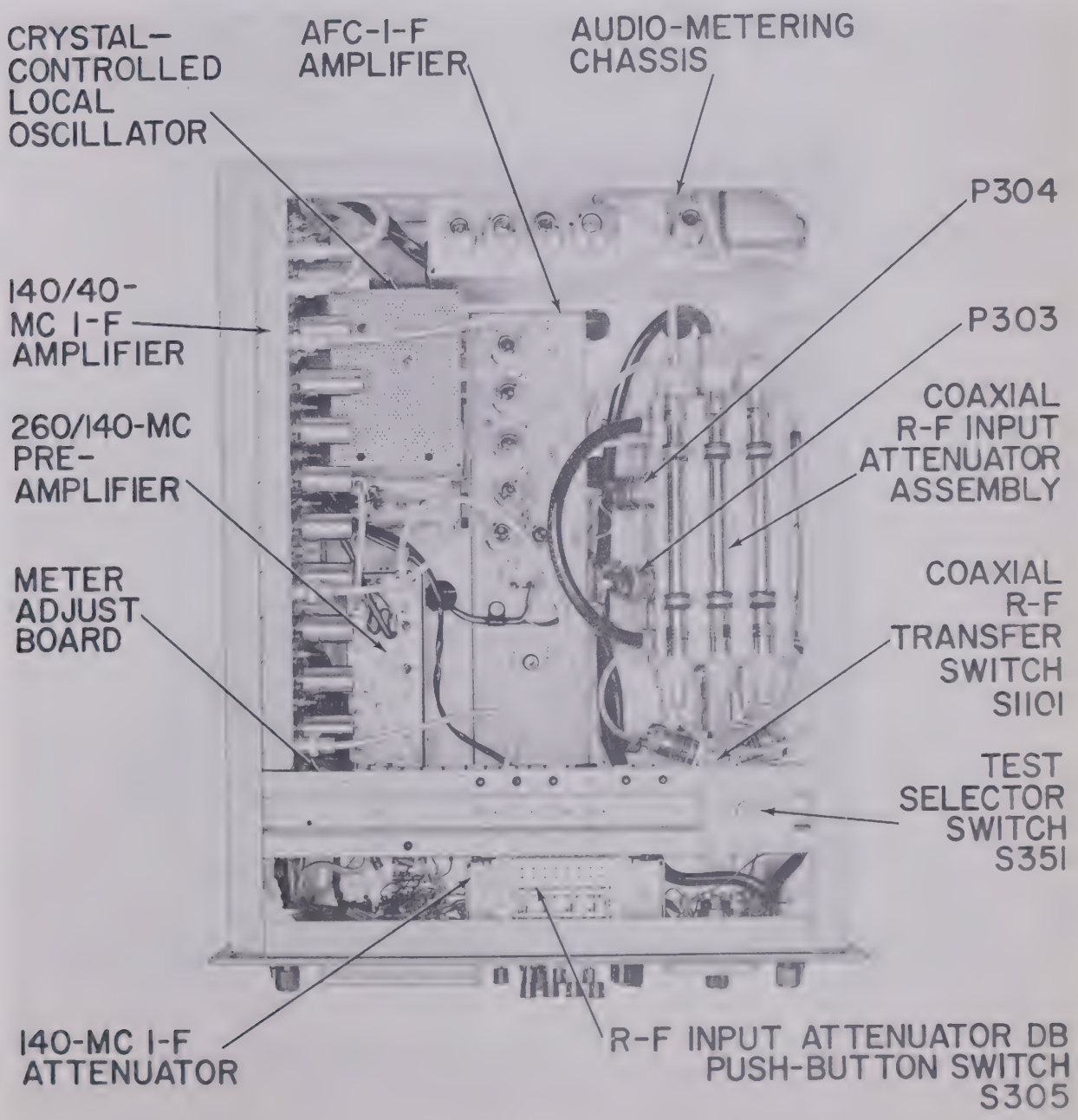


Figure 4-10. Basic Unit Subassembly Location Diagram

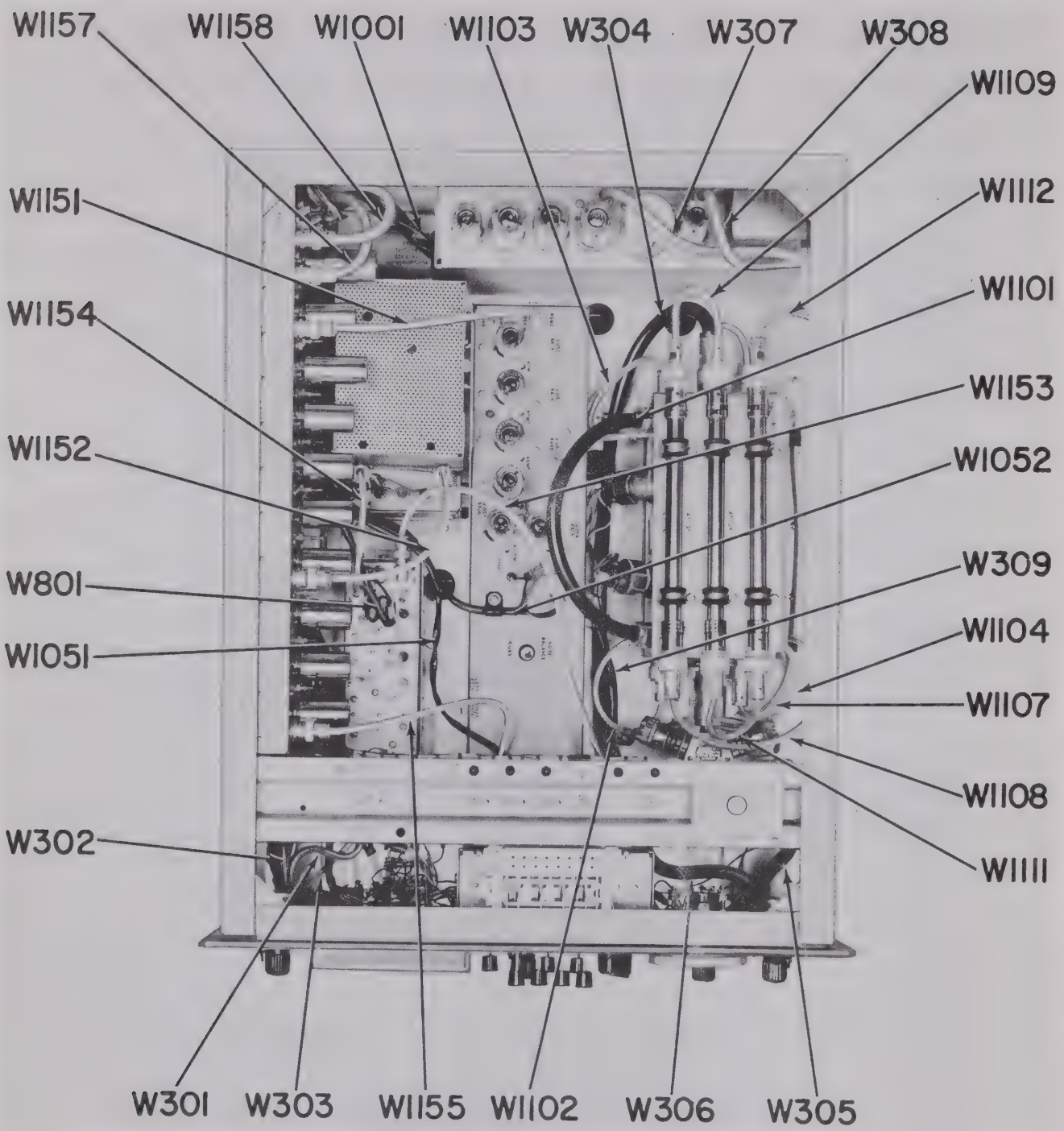


Figure 4-11. Basic Unit Interconnecting Cable Location Diagram (Sheet 1 of 3)

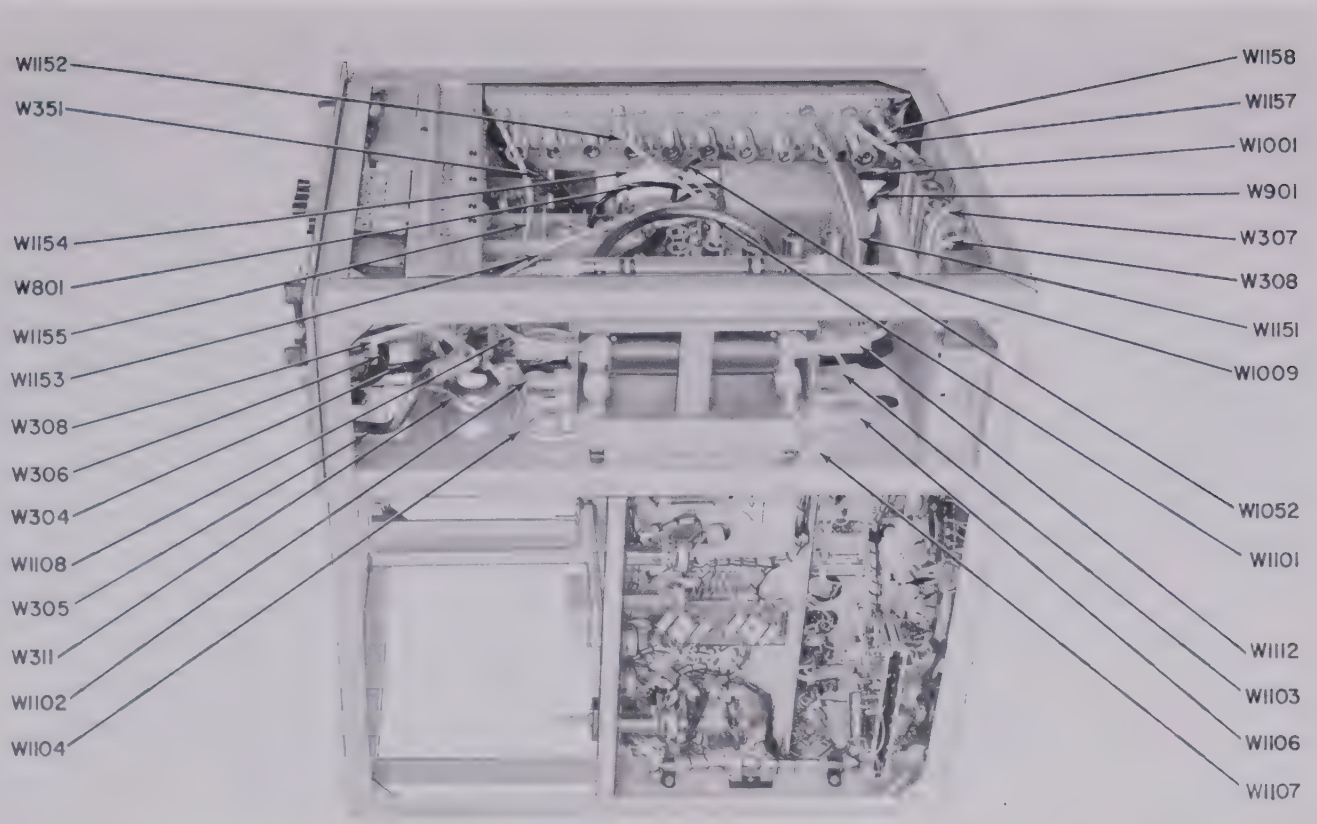


Figure 4-11. Basic Unit Interconnecting Cable Location Diagram
(Sheet 2 of 3)

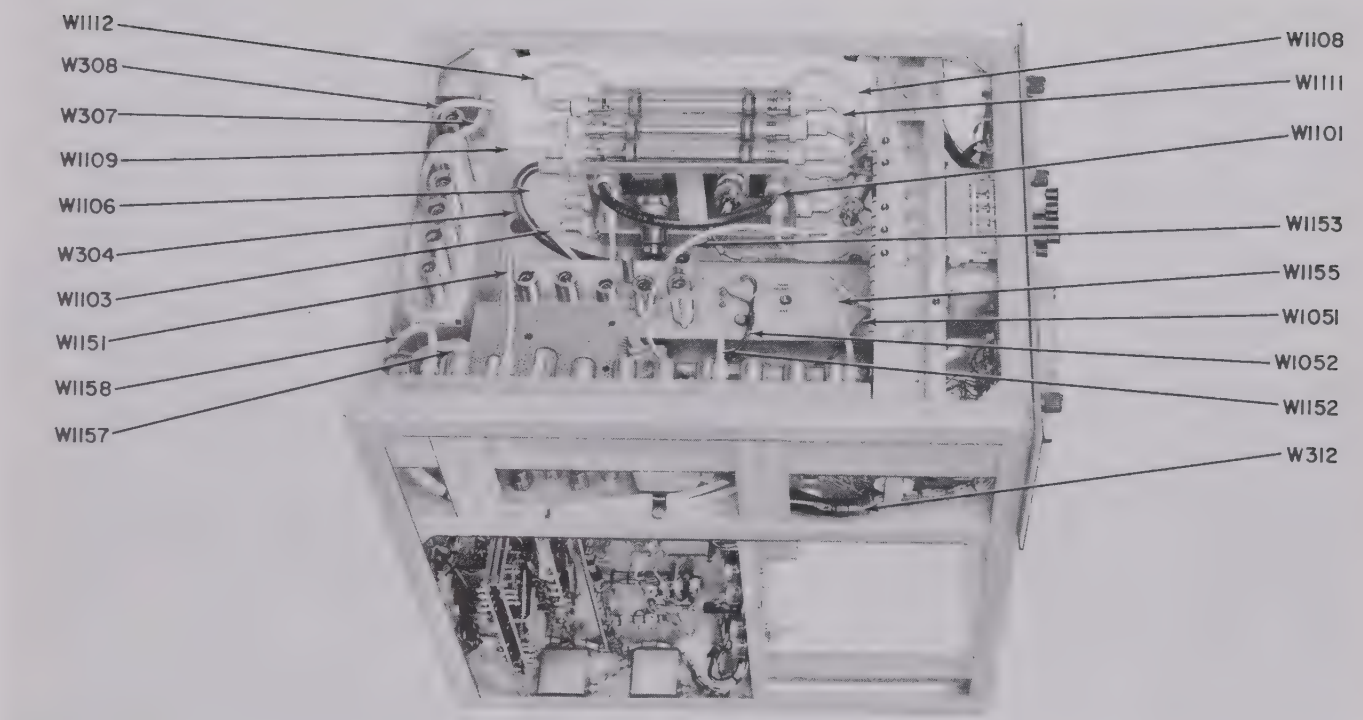


Figure 4-11. Basic Unit Interconnecting Cable Location Diagram
(Sheet 3 of 3)

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE.

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
1	140-mc i-f attenuator input jack J326	Calibrated signal generator	Remove all i-f attenuation. Connect the signal generator to J326, as shown in figure 4-12, sheet 1. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Note the output meter pointer deflection	Output meter pointer deflects to an indication of 1000 (+60, -56) microvolts on the RF UV scale	Trouble lies in i-f cable assembly W1153, the 120-mc section of the crystal-controlled local oscillator, i-f cable assembly W1154, i-f cable assembly W303, or the 260/140-mc preamplifier. Proceed to step 2.	Trouble lies between the 140-mc i-f attenuator input jack and the output meter. Proceed to step 6.
2	I-f cable assembly W1153	Ohmmeter	W1153 disconnected from both 140-mc i-f attenuator input jack J326 and 260/140-mc preamplifier output jack J802.	Continuity from end to end of cable for both inner and outer conductors. Infinite resistance between inner and outer conductor at each end of cable	Trouble lies in 120-mc section of crystal-controlled local oscillator, i-f cable W1154, i-f cable W303, or 260/140-mc preamplifier. Proceed to step 3.	I-f cable assembly W1153 defective. Repair or replace as required.
3	Crystal-controlled local oscillator output jack J851	50-ohm detector (see figure 4-13) and vtvm	Rotate the AURAL AID control fully counterclockwise to its "off" position. Connect the vtvm, through the 50-ohm detector, to J851, as shown in figure 4-12, sheet 2.	Vtvm indicates between 1.3 and 1.5 volts.	Trouble lies in i-f cable assembly W1154, i-f cable assembly W303, or 260/140-mc preamplifier. Proceed to step 4.	120-mc section of crystal-controlled local oscillator defective. Refer to paragraph 4-16.
4	I-f cable assembly W1154	Ohmmeter	W1154 disconnected from both crystal-controlled local oscillator output jack J851 and 260/140-mc preamplifier input jack J803.	Same as step 2.	Trouble lies in i-f cable assembly W303 or 260/140-mc preamplifier. Proceed to step 5.	I-f cable assembly W1154 defective. Repair or replace as required.
5	I-f cable assembly W303 and IF IN jack J308	Ohmmeter	W303 disconnected from 260/140-mc preamplifier input jack J801.	Same as step 2.	Trouble lies in 260/140 preamplifier. Refer to paragraph 4-23.	I-f cable assembly W303 defective. Repair or replace as required.

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
6	140/40-mc i-f amplifier input jack J900.	Calibrated signal generator.	Connect the signal generator to J900, as shown in figure 4-12, sheet 3. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Note the output meter pointer deflection.	Same as step 1.	Trouble lies in i-f cable assembly W1155 or 140-mc i-f attenuator. Proceed to step 7.	Trouble lies between 140/40-mc i-f amplifier and output meter. Proceed to step 8.
7	I-f cable assembly W1155.	Ohmmeter.	W1155 disconnected from both 140-mc i-f attenuator output jack J325 and 140/40-mc i-f amplifier input jack J900.	Same as step 2.	Trouble lies in 140-mc i-f attenuator. Refer to paragraph 4-31.	I-f cable assembly W1155 defective. Repair or replace as required.
8	140/40-mc i-f amplifier output jack J902.	Calibrated signal generator, 50-ohm crystal detector (see figure 4-13), and vtvm.	Connect the signal generator to J900, as shown in figure 4-12, sheet 4. Tune the signal generator to 140 mc and adjust its output level to 4 microvolts. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale. Adjust the output level of the signal generator to 400 microvolts. Connect the vtvm, through the 50-ohm crystal detector to J902, as shown in figure 4-12, sheet 4. Note the vtvm indication.	Vtvm indicates between 0.7 and 0.8 volts.	Trouble lies between 140/40-mc i-f amplifier detectors and output meter. Proceed to step 11.	If signal is less, trouble lies in i-f cable assembly W1152, the 180-mc section of the crystal-controlled local oscillator, or the first eight stages of the 140/40-mc i-f amplifier. Proceed to step 9. If the signal is greater than 1 volt, the trouble lies between the weighting circuitry and the output meter. Proceed to paragraph 4-48.
9	I-f cable assembly W1152.	Ohmmeter	W1152 disconnected from both crystal-controlled local oscillator output jack J850 and 140/40-mc i-f amplifier input jack J901.	Same as step 2.	Trouble lies in 180-mc section of crystal-controlled local oscillator or first eight stages of the 140/40-mc i-f amplifier. Proceed to step 10.	I-f cable assembly W1152 defective. Repair or replace as required.

TABLE 4-6. I-F TROUBLESHOOTING PROCEDURE (cont'd).

STEP	TEST POINT	TEST EQUIPMENT	INSTRUCTIONS	NORMAL INDICATION	IF INDICATION NORMAL	IF INDICATION ABNORMAL
10	Crystal-controlled local oscillator output jack J850.	50-ohm crystal detector (see figure 4-13) and vtvm.	Vtvm connected to J850 through 50-ohm crystal detector, as shown in figure 4-12, sheet 5.	Vtvm indicates between 1.0 and 1.5 volts.	Trouble lies in first eight stages of 140/40-mc i-f amplifier. Refer to paragraph 4-37.	180-mc section of crystal-controlled local oscillator defective. Refer to paragraph 4-16.
11	140/40-mc i-f amplifier output jack J903.	Calibrated signal generator, 10K resistor, and vtvm.	Connect signal generator to J900, as shown in figure 4-12, sheet 6. Adjust output level of signal generator to 4 microvolts. Adjust IF GAIN control to obtain output meter pointer deflection of 10 on RF UV scale. Adjust output level of signal generator to 400 microvolts. Connect 10K resistor between J903 and chassis ground, as shown in figure 4-12, sheet 6. Connect vtvm across 10K resistor.	Vtvm indicates between -40 and -50 volts.	Trouble lies between video cable assembly W1157 and output meter. Proceed to step 12.	Trouble lies in last two stages of 140/40-mc i-f amplifier. Refer to paragraph 4-37.
12	Video cable assembly W1157.	Ohmmeter.	W1157 disconnected from J903.	Same as step 2.	Trouble lies in audio-metering chassis or weighting circuitry. Refer to paragraphs 4-46 or 4-48, respectively.	Video cable assembly W1157 defective. Repair or replace as required.
13	Afc-i-f amplifier output connector P1051.	Calibrated signal generator, vtvm, 1-megohm resistor.	Calibrated signal generator connected to J1050, as shown in figure 4-12, sheet 7. Signal generator tuned to 38.25 mc and adjusted for an output level of 50,000 microvolts. Positive probe of vtvm connected to pin B of P1051 through 1-megohm resistor, as shown in figure 4-12, sheet 7. Common probe of vtvm connected to pin A of P1051. Note vtvm indication. Adjust signal generator for 50,000 microvolts at 41.75 mc. Reverse vtvm probes. Note vtvm indication.	Vtvm indicates approximately 3.5 volts in each position.	——	Afc-i-f amplifier defective. Refer to paragraph 4-52.

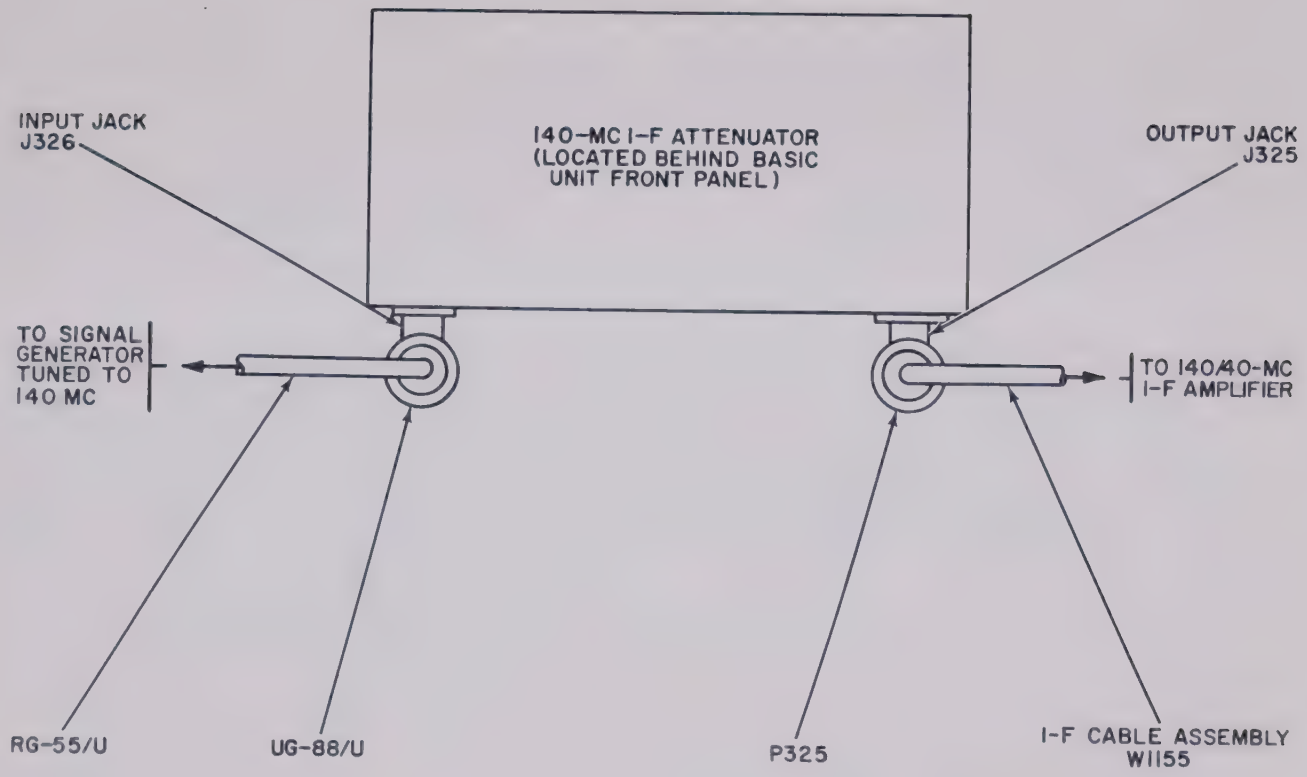


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up
(Sheet 1 of 7)

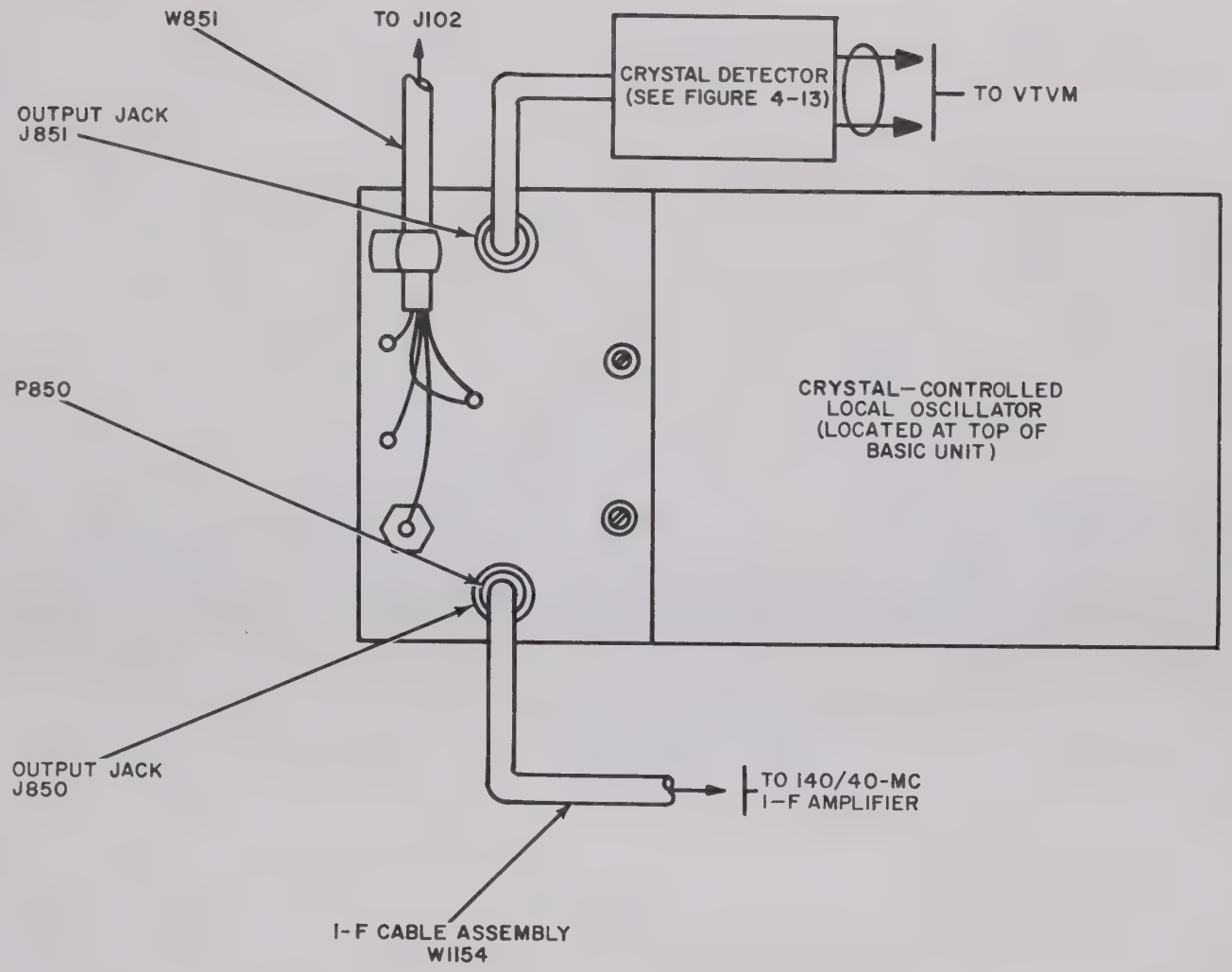


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 2 of 7)

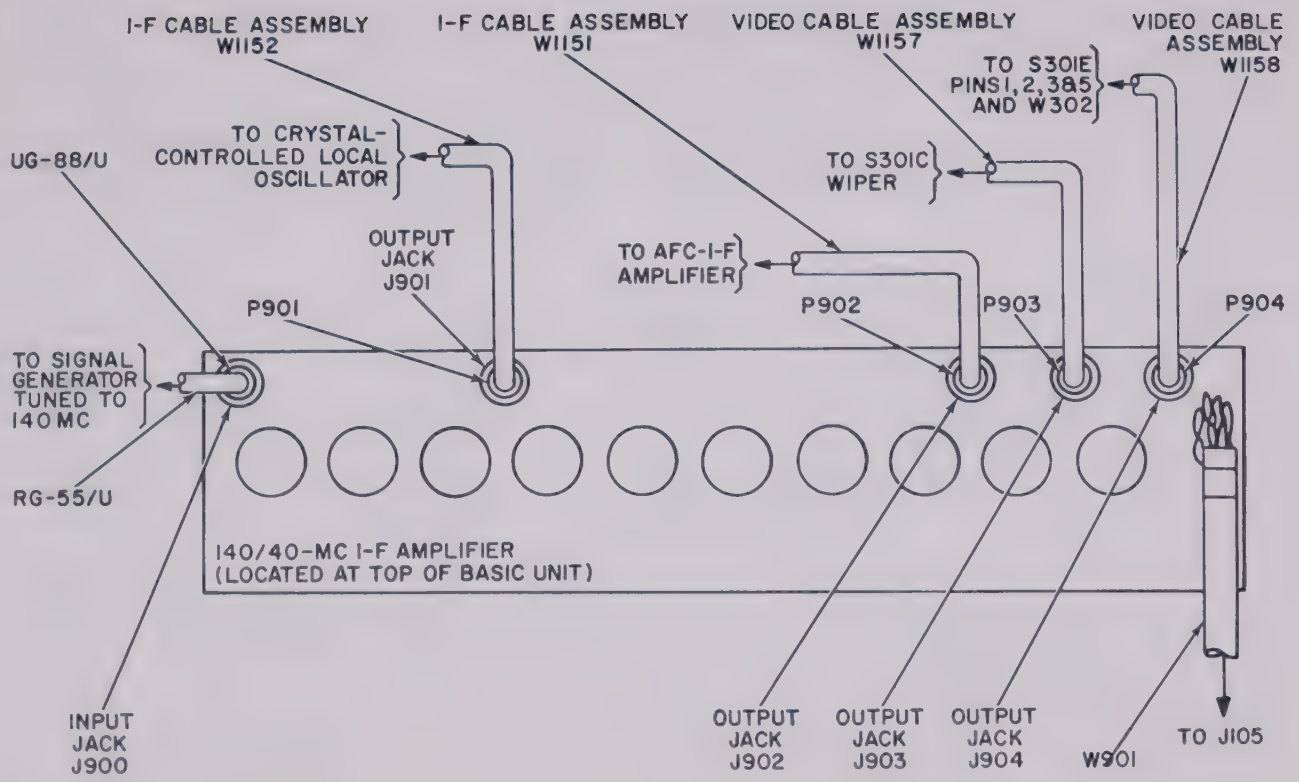


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 3 of 7)

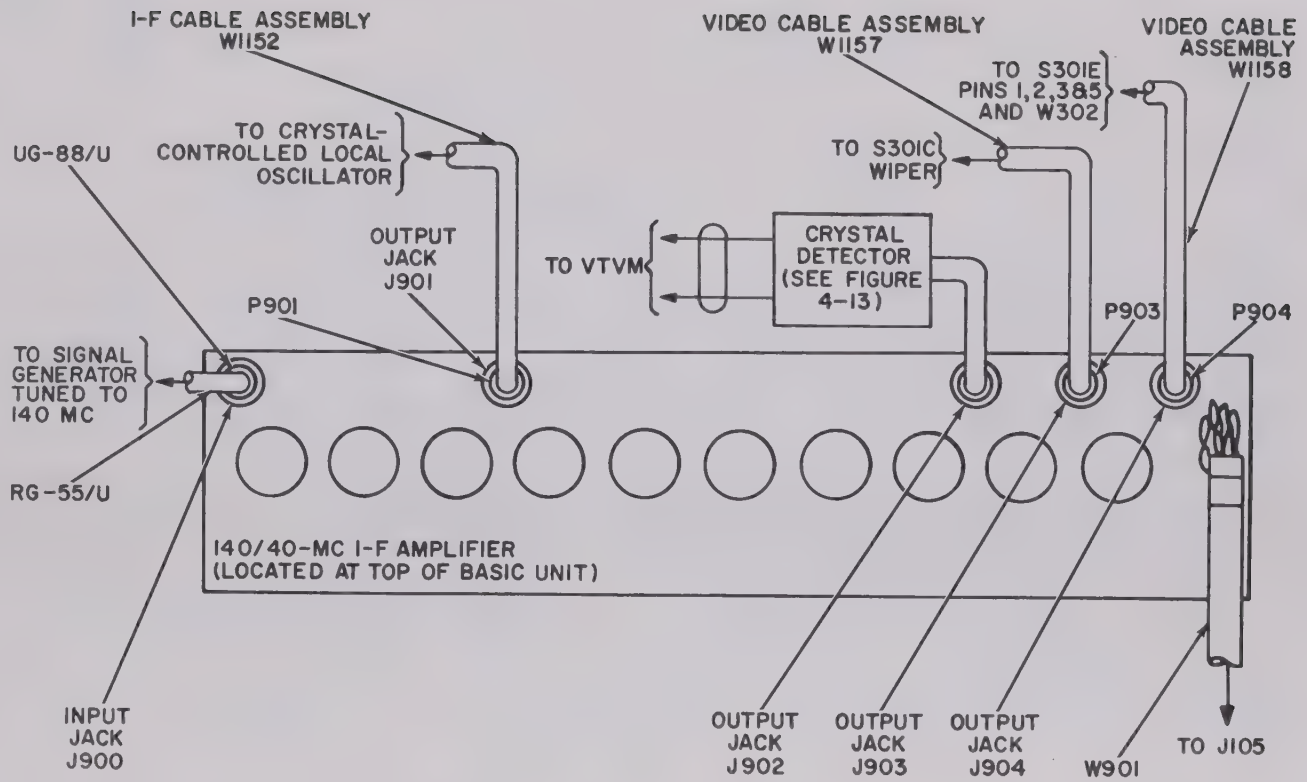


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 4 of 7)

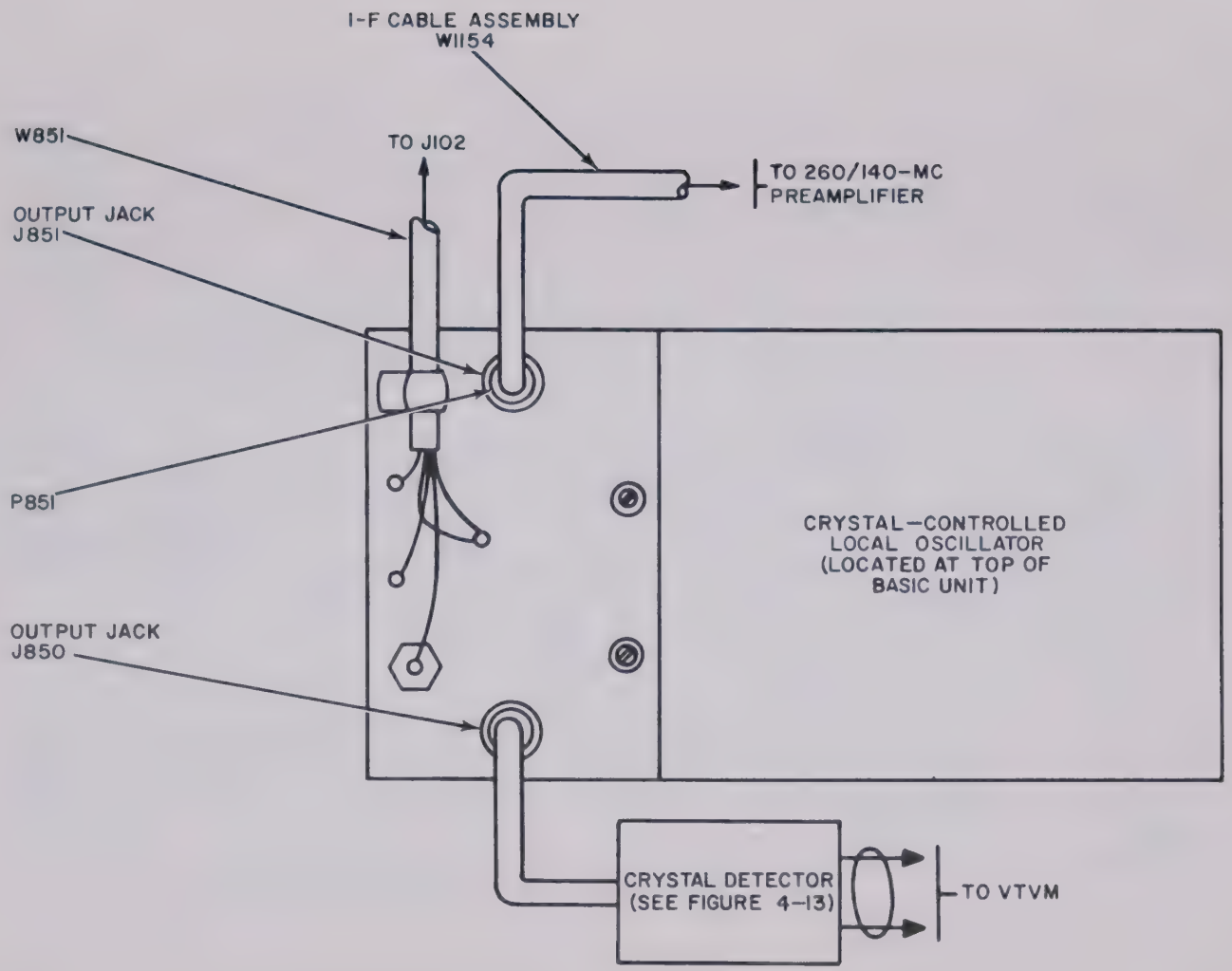


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 5 of 7)

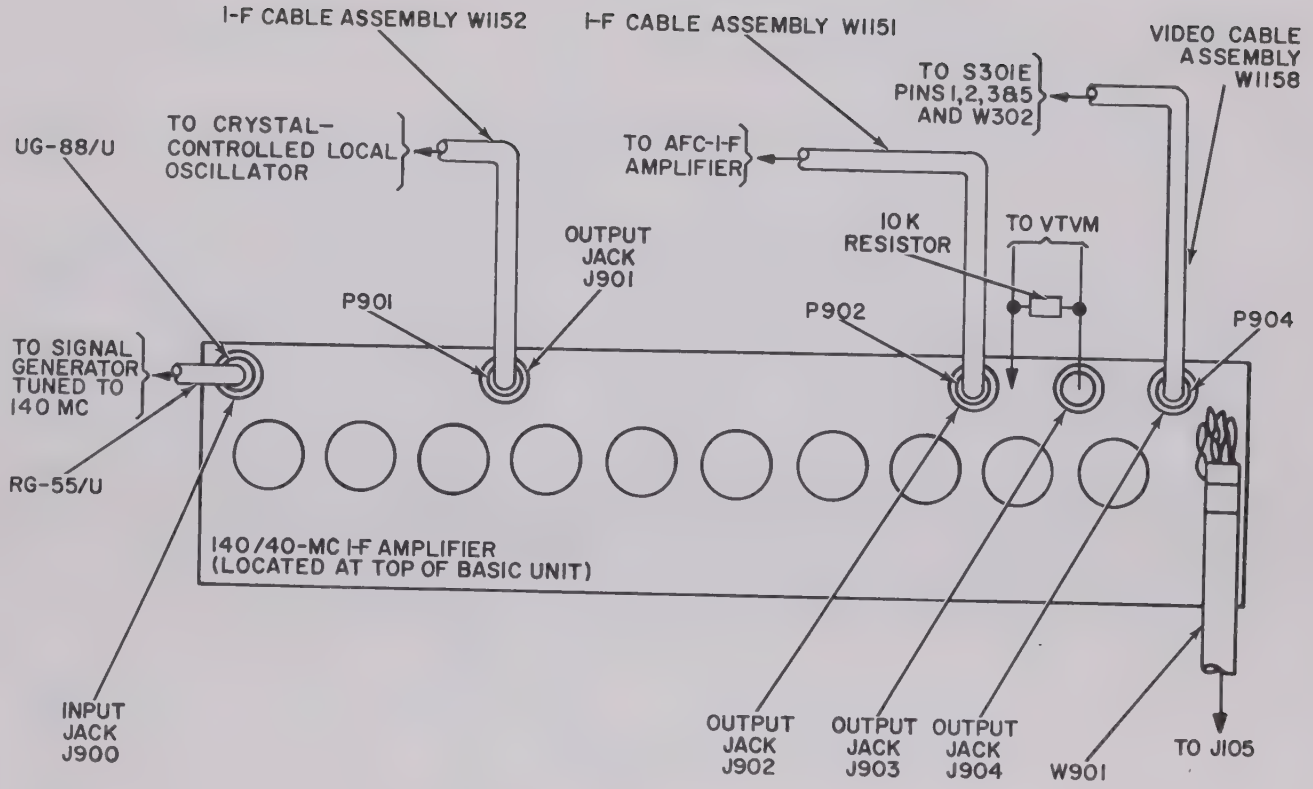


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 6 of 7)

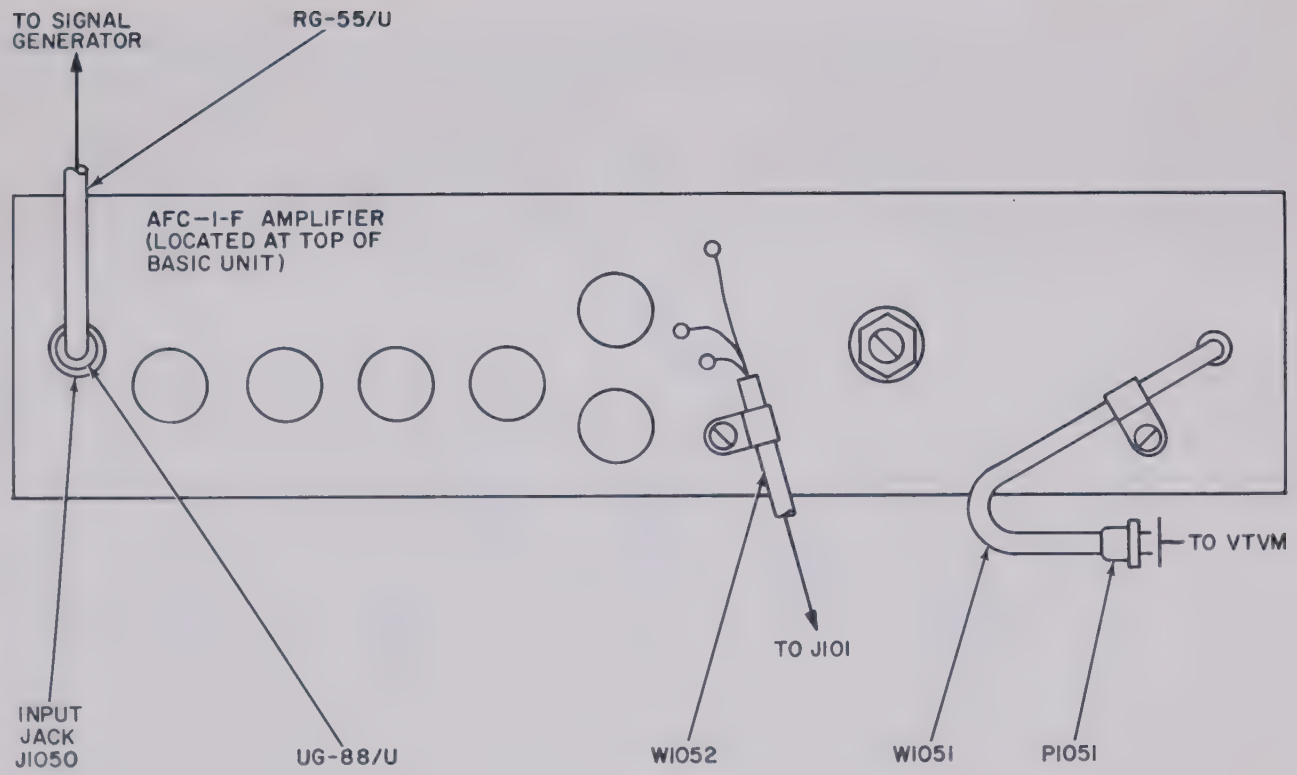


Figure 4-12. Localizing I-f Circuitry Trouble, Equipment Set Up (Sheet 7 of 7)

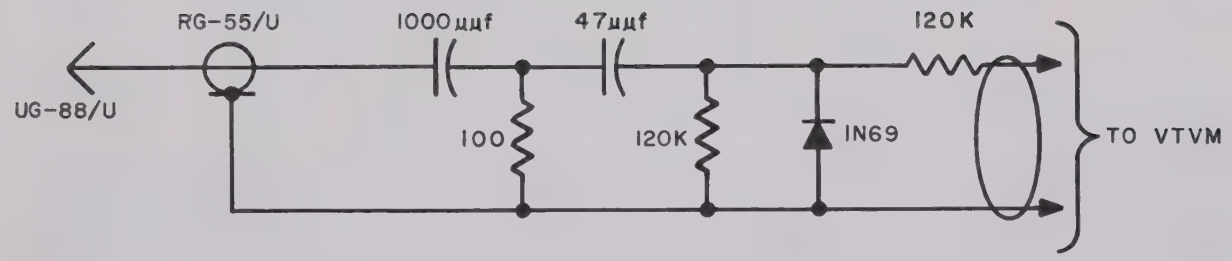


Figure 4-13. 50-Ohm Crystal Detector, Schematic Diagram

4-16. CRYSTAL-CONTROLLED LOCAL OSCILLATOR, TROUBLESHOOTING.

4-17. To remove the crystal-controlled local oscillator subassembly from the Basic Unit frame for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

a. Disconnect P850 from J850.

b. Disconnect P851 from J851.

c. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

d. Remove the crystal-controlled local oscillator from the Basic Unit by disconnecting P852 from J102 and withdrawing the subassembly.

e. Loosen and remove the eight screws that secure the mounting plate and the shield to the subassembly. Again, place the screws and their associated hardware in an accessible location.

f. Remove the mounting plate and the shield from the crystal-controlled local oscillator subassembly. The individual components that constitute the chassis will now be visible and accessible.

4-18. A defect within the crystal-controlled local oscillator can be found by use of the component location diagram supplied in figure 4-14, the voltage and resistance measurements supplied in table 4-7, and the schematic diagram of the subassembly supplied in figure 5-5.

NOTE:

When making voltage and resistance measurements, be sure to connect P852 to J102, thereby coupling the crystal-controlled local oscillator to the remainder of the FIM-2 system.

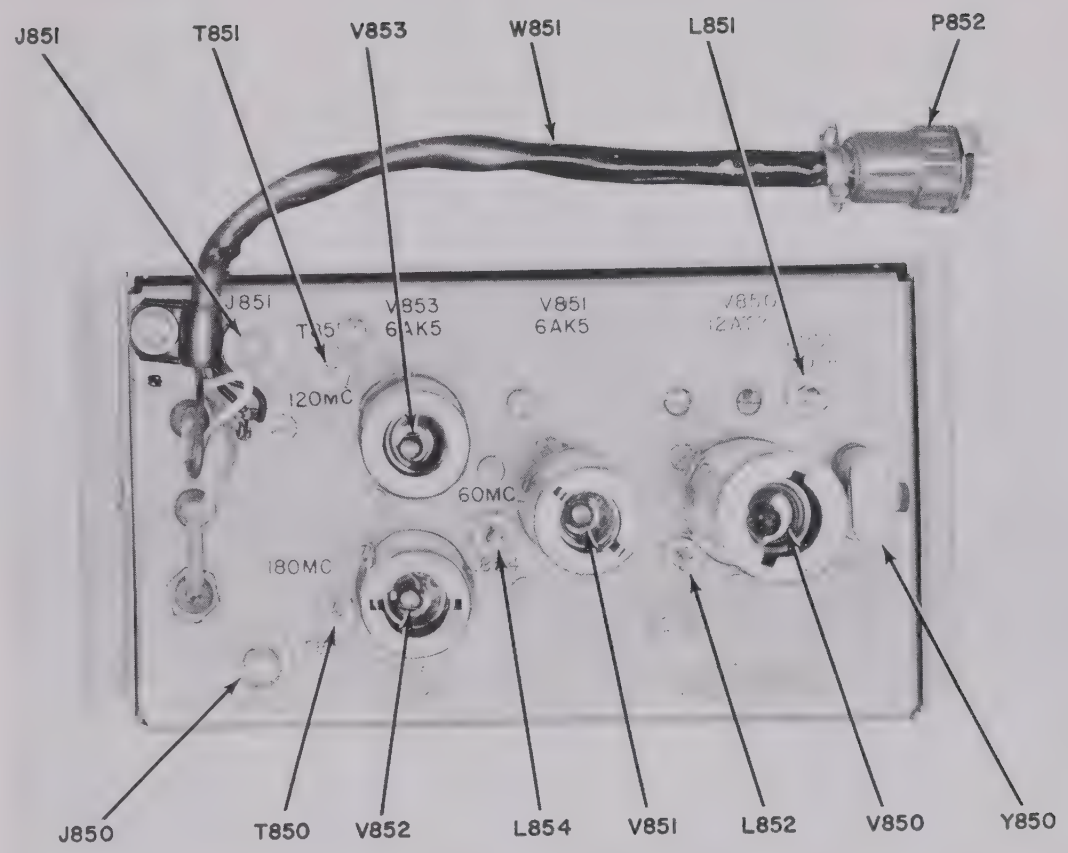


Figure 4-14. Crystal-Controlled Local Oscillator, Component Location Diagram (Sheet 1 of 3)

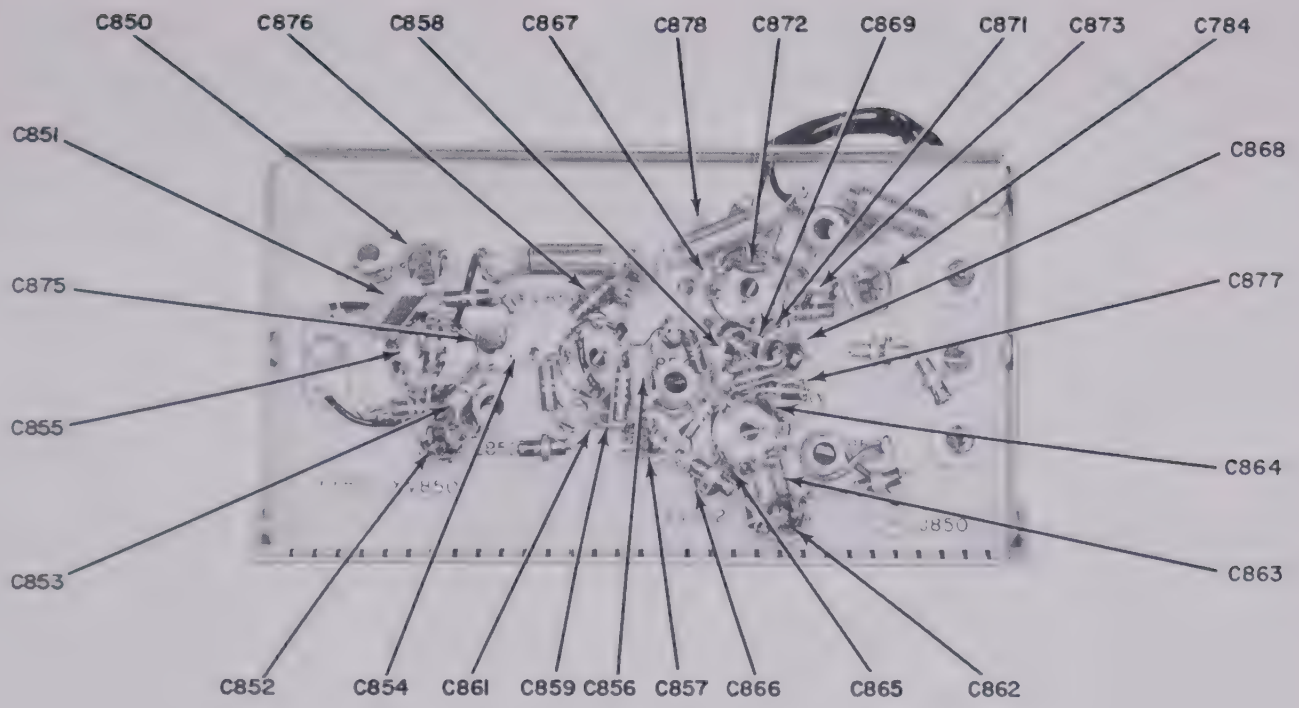


Figure 4-14. Crystal-Controlled Local Oscillator, Component Location Diagram (Sheet 2 of 3)

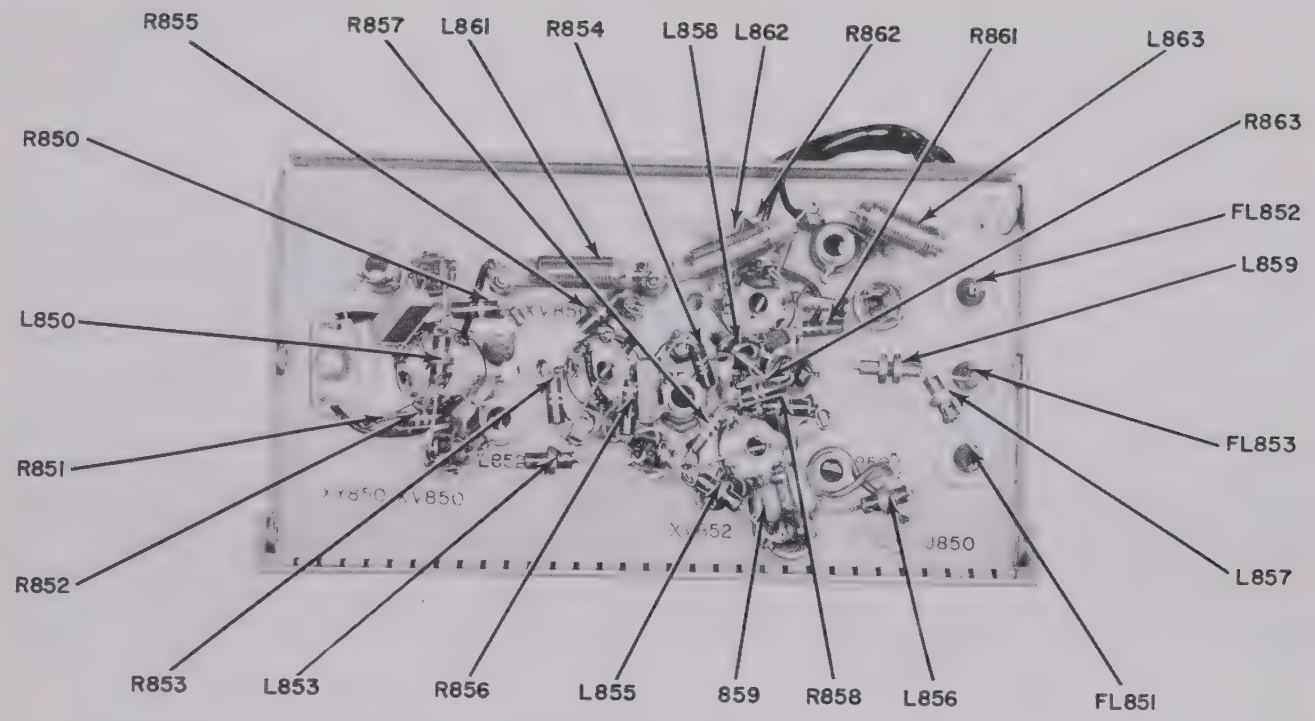


Figure 4-14. Crystal-Controlled Local Oscillator, Component Location Diagram (Sheet 3 of 3)

Table 4-7. Crystal-Controlled Local Oscillator, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV850	12AT7	+130 4.5K	0 15K	+1.25 220	0 0	0 0	+130 6.5K	0 0	+1.25 250	6.3AC 0.2	Volts Ohms
XV851	6AK5	-1.2 25K	+2.0 200	6.3AC 0.2	0 0	+130 7K	+120 12K	+2.0 200			Volts Ohms
XV852	6AK5	-5.4 30K	+2.0 200	6.3AC 0.2	0 0	+130 7K	+120 12K	+2.0 200			Volts Ohms
XV853	6AK5	-5.0 25K	+2.0 200	6.3AC 0.2	0 0	+130 7K	+120 12K	+2.0 200			Volts Onms

Notes:

1. Voltage readings taken with a 20,000 ohm-per-volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.

4-19. CRYSTAL-CONTROLLED LOCAL OSCILLATOR, ALIGNMENT.

4-20. Since the circuitry of this subassembly is crystal-controlled, alignment will necessitate only peaking adjustments and/or tube replacement. To align the crystal-controlled local oscillator, proceed as outlined in the following steps.

a. Connect an a-c vtvm, through a 1-megohm series resistor, between pin 2 of V850 and chassis ground.

NOTE:

Adjustment of variable inductor L851 is critical. Since the output level of the 120-mc and 180-mc stages is dependent upon the output of the 60-mc stage, improper or poor peaking of L851 will result in low output power of the following stages regardless of their peaking.

b. Adjust variable inductor L851 to peak the deflection of the vtvm pointer.

c. Connect the vtvm and 1-megohm series resistor between pin 1 of V851 and chassis ground.

d. Adjust variable inductor L852 to peak the deflection of the vtvm pointer.

e. Connect the vtvm and 1-megohm series resistor between pin 1 of V852 and chassis ground.

f. Adjust variable inductor L854 to peak the deflection of the vtvm pointer.

g. Connect a d-c vtvm, through the 50-ohm crystal detector, to coaxial output jack J850, as shown in figure 4-12, sheet 5 of 7.

h. Adjust tunable transformer T850 to peak the deflection of the vtvm pointer. The vtvm should deflect to an indication of from 1.3 to 1.5 volts.

i. Connect the d-c vtvm, through the 50-ohm crystal detector, to coaxial output jack J851, as shown in figure 4-12, sheet 2 of 7.

j. Adjust tunable transformer T851 to peak the deflection of the vtvm pointer. The vtvm pointer should deflect to an indication of from 1.0 to 1.5 volts.

4-21. If the output levels specified in steps h and j, above, cannot be obtained, check the grid-to-ground voltages of the individual tubes within the subassembly with a d-c vtvm and 1-megohm series resistor. The following approximate voltage indications should be obtained.

a. Between pin 2 of V850 and ground ..... -3.5 volts

b. Between pin 1 of V851 and ground ..... -6.5 volts

c. Between pin 1 of V852 and ground ..... -14 volts

d. Between pin 1 of V853 and ground ..... -8.5 volts

4-22. After the crystal-controlled local oscillator has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 417, steps a through f.

4-23. 260/140-MC PREAMPLIFIER, TROUBLESHOOTING.

4-24. To remove the 260/140-mc preamplifier subassembly from the Basic Unit for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

a. Disconnect P801 from J801.

b. Disconnect P802 from J802.

c. Disconnect P803 from J803.

d. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

e. Remove the 260/140-mc preamplifier from the Basic Unit by disconnecting P804 from J103 and withdrawing the subassembly.

f. Loosen and remove the four screws that secure the mounting plate to the subassembly. Again, place the screws and their associated hardware in an accessible location.

g. Remove the mounting plate from the 260/140-mc preamplifier chassis. The components that constitute the subassembly will now be visible and accessible.

4-25. A defect within the 260/140-mc preamplifier can be located through the component location diagram supplied in figure 4-15, the voltage and resistance diagram supplied in figure 4-16, and the schematic diagram of the subassembly supplied in figure 5-5.

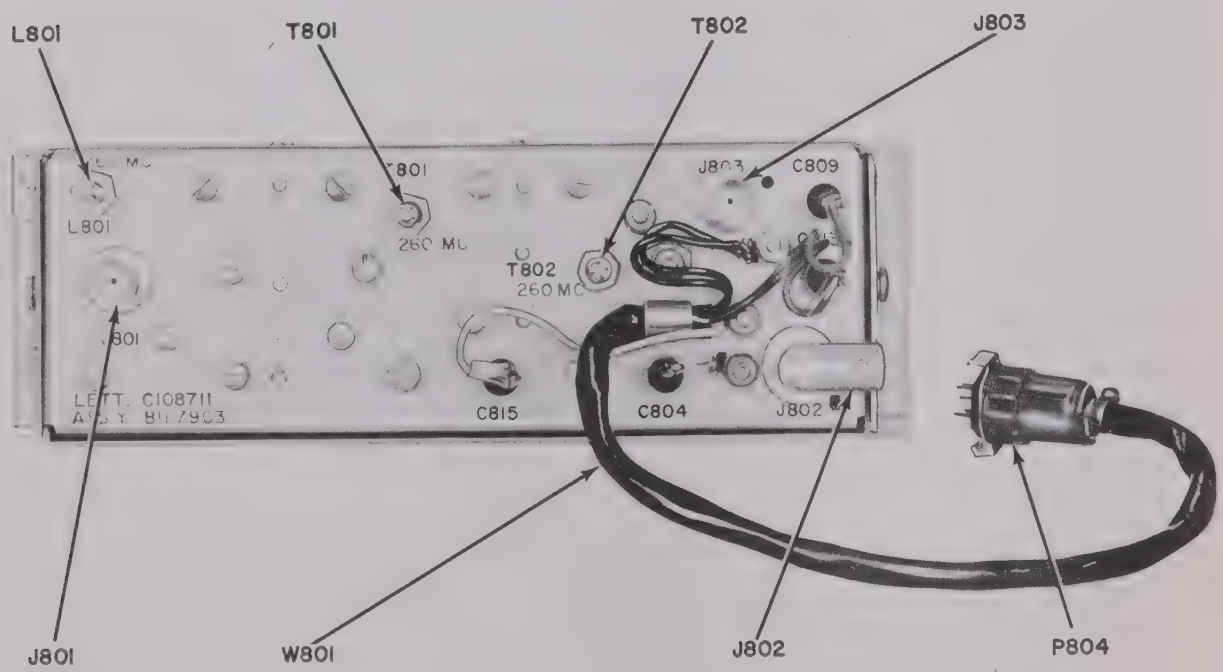


Figure 4-15. 260/140-Mc Preamplifier, Component Location Diagram (Sheet 1 of 3).

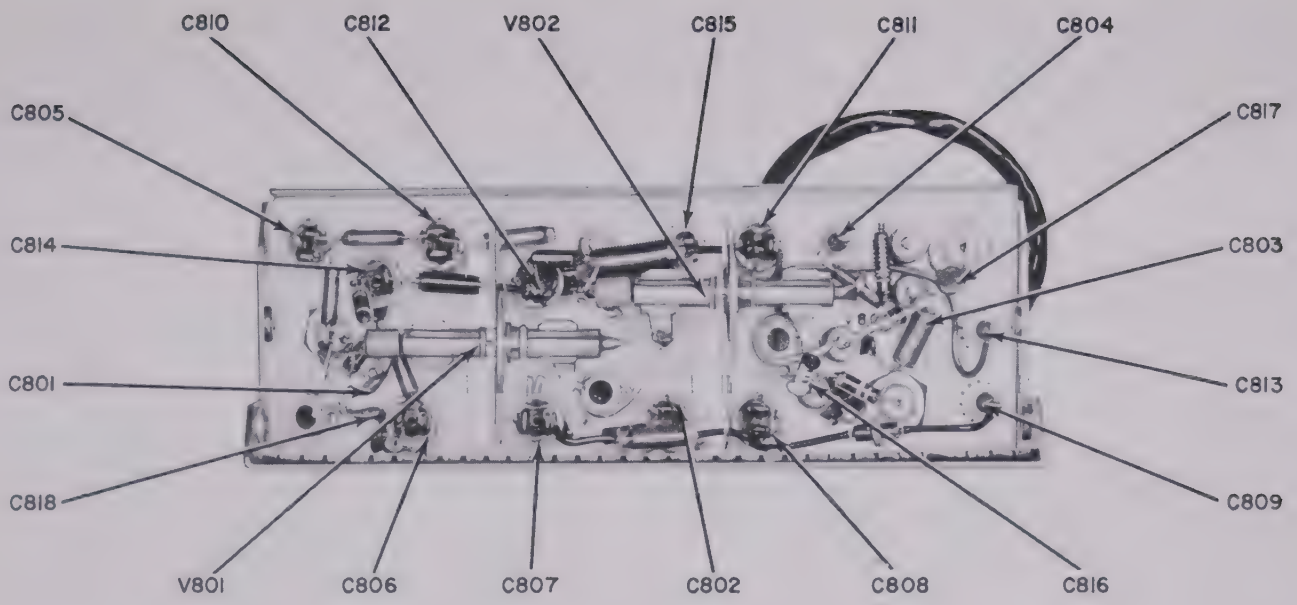


Figure 4-15. 260/140-Mc Preamplifier, Component Location Diagram (Sheet 2 of 3)

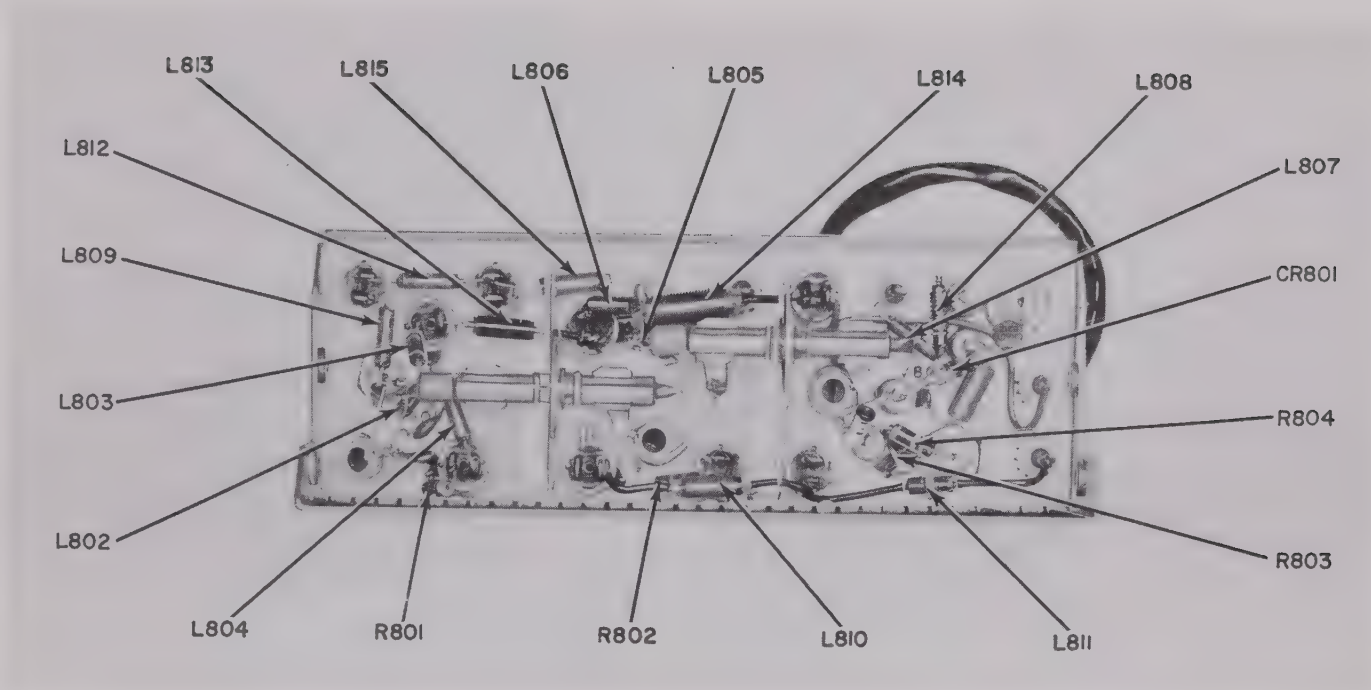


Figure 4-15. 260/140-Mc Preamplifier, Component Location Diagram (Sheet 3 of 3)

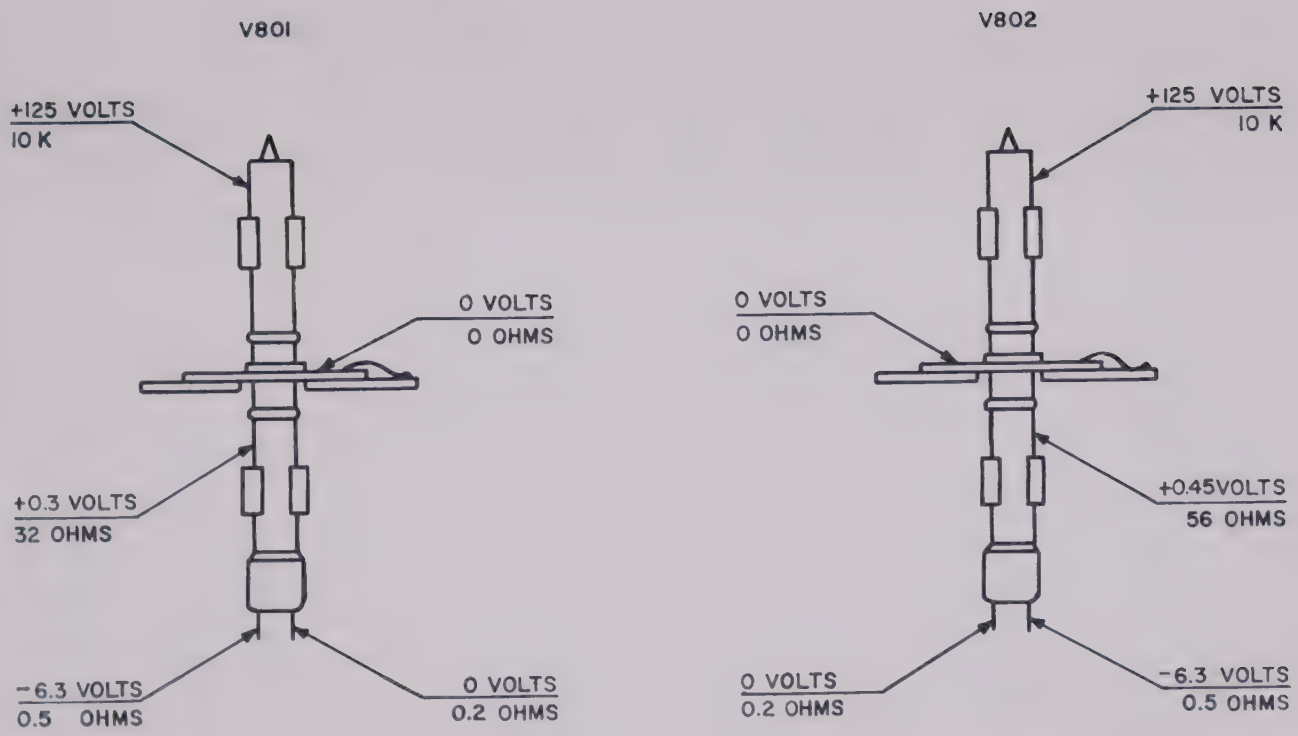


Figure 4-16. 260/140-Mc Preamplifier, Voltage and Resistance Diagram

4-26. 260/140-MC PREAMPLIFIER, ALIGNMENT.

4-27. To align the 260/140-mc preamplifier subassembly, proceed as outlined in the following steps.

NOTE:

The following procedure is valid only if the 140-mc i-f attenuator, 140/40-mc i-f amplifier, and crystal-controlled local oscillator subassemblies are functioning properly.

a. Connect P802 to J802.

b. Connect P803 to J803.

c. Set the OUTPUT switch to ZERO SET.

d. Connect the positive probe of a d-c vtvm to TP900 (located on the 140/40-mc i-f amplifier subassembly). Connect the common probe to chassis ground.

e. Connect a calibrated signal generator, tuned to 260 mc, to coaxial input jack J801.

f. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

g. Adjust the IF GAIN control to a front-panel indication of 6.

h. Adjust the output level of the signal calibrator to obtain a vtvm pointer deflection of approximately five volts.

i. Adjust tunable transformer T802 to peak the deflection of the vtvm pointer.

j. Adjust tunable transformer T801 to obtain maximum deflection of the vtvm pointer.

k. Adjust variable inductor L801 to further peak the deflection of the vtvm pointer. Reduce the output level of the signal generator, if necessary, to maintain the vtvm pointer deflection on-scale.

4-28. SENSITIVITY CHECK. To check the sensitivity of the 260/140-mc preamplifier (in series with the 140/40-mc i-f amplifier), proceed as outlined in the following steps.

a. Adjust the calibrated signal generator to obtain the minimum output level at 260 mc.

b. With the d-c vtvm still connected between TP900 of the 140/40-mc i-f amplifier and chassis ground, adjust the IF GAIN control to obtain a vtvm pointer deflection of 1 volt.

c. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 1.41 volts. The amplitude of the 260-mc signal necessary to produce this indication should be no greater than 3 microvolts.

4-29. BANDWIDTH CHECK. To check the bandwidth of the series combination of the 260/140-mc preamplifier and the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. With the d-c vtvm still connected between TP900 and chassis ground, adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 10 volts.

b. Detune the calibrated signal generator, while maintaining its output level at a constant level, to obtain both the upper and lower 3-db points (vtvm pointer deflecting to an indication of 7.07 volts). A 3-db bandwidth of 3.5 mc indicates satisfactory operation.

c. Repeat steps a and b, above, to obtain both the upper and lower 6-db points (vtvm pointer deflection of 5 volts). A 6-db bandwidth of between 4.5 and 5.5 mc indicates satisfactory equipment operation.

4-30. After the 260/140-mc preamplifier subassembly has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-23, steps a through g.

4-31. 140-MC I-F ATTENUATOR, TROUBLESHOOTING.

4-32. To remove the 140-mc i-f attenuator subassembly from the Basic Unit for troubleshooting and effecting necessary repairs, proceed as outlined in the following steps.

a. Disconnect P326 from J326.

b. Disconnect P325 from J325.

c. Remove the plastic front panel cover of the output meter.

d. Loosen (but do not remove) the screws which secure the output meter to the Basic Unit front panel.

e. Loosen and remove the four screws that secure the 140-mc i-f attenuator subassembly to the Basic Unit front panel. Place the screws and their associated hardware in an accessible location.

f. Carefully remove the five plastic push-buttons from the 140-mc i-f attenuator subassembly switch shafts. Place these buttons with the mounting hardware.

g. Remove the subassembly from the Basic Unit.

h. Loosen and remove the four screws that secure the cover plate to the subassembly. Again, place the screws and their associated hardware in an accessible location.

1. Remove the cover plate from the subassembly. The components that constitute the 140-mc i-f attenuator will now be visible and accessible.

4-33. A defect within the 140-mc i-f attenuator subassembly can be located through the component location diagram supplied in figure 4-17 and the schematic diagram of the subassembly supplied in figure 5-5.

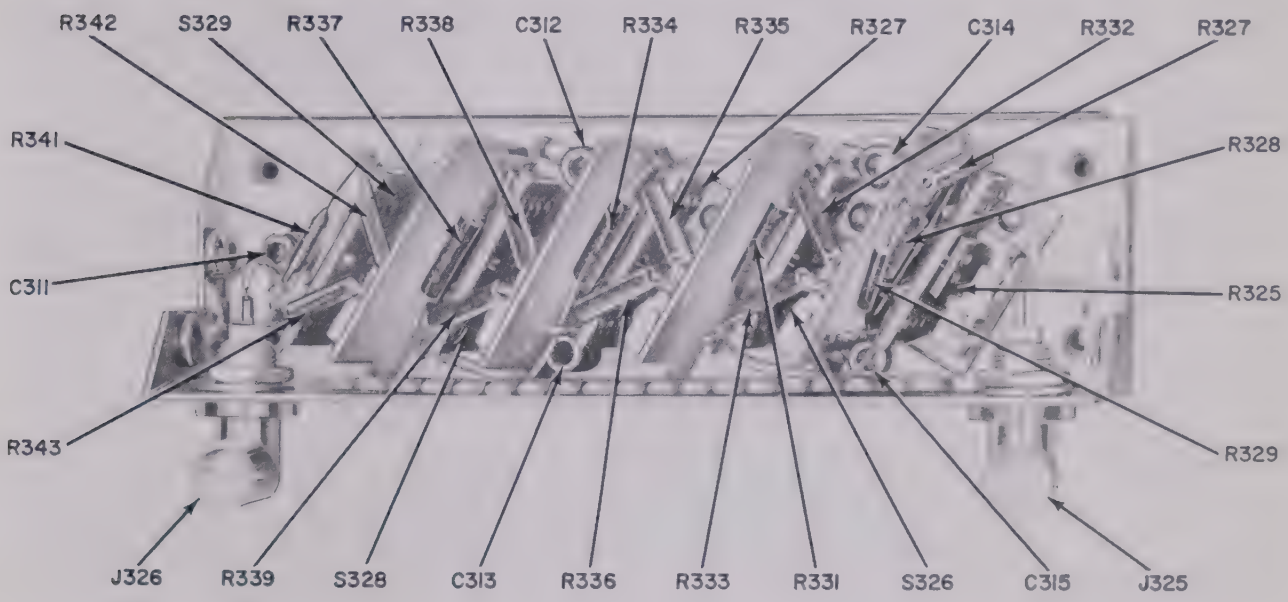


Figure 4-17. 140-Mc I-f Attenuator, Component Location Diagram.

4-34. 140-MC I-F ATTENUATOR, ALIGNMENT.

4-35. Since the 140-mc i-f attenuator subassembly is of the compensated section type, alignment will necessitate the adjustment of the compensating capacitors of the stage(s) that was (were) repaired. To align the capacitors, proceed as outlined in the following steps.

a. Connect a calibrated signal generator, tuned to 140 mc and adjusted for a convenient output level, to the input jack of a standard 50-ohm i-f attenuator, as shown in figure 4-18a.

b. Connect the output of the standard 50-ohm i-f attenuator to J900 of the 140/40-mc i-f amplifier, as shown in figure 4-18a.

c. Insert the amount of i-f attenuation corresponding to that stage of the 140-mc i-f attenuator that was repaired.

d. Note the output meter pointer deflection.

e, Replace the standard 50-ohm i-f attenuator with the 140-mc i-f attenuator, as shown in figure 4-18b.

f. Depress the push-button switch to insert the repaired stage of attenuation. All other stages should not be inserted into the circuit.

g. Note the output meter pointer deflection. Adjust the appropriate compensating capacitor so that the output meter pointer deflection is the same as that of step d, above.

h. Repeat steps a through g, if necessary, for all other stages that were repaired.

4-36. After the 140-mc i-f attenuator assembly has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-32, steps a through i.

4-37. 140/40-MC I-F AMPLIFIER, TROUBLESHOOTING.

4-38. To remove the 140/40-mc i-f amplifier subassembly from the Basic Unit frame, proceed as outlined in the following steps.

a. Disconnect P900 from J900.

b. Disconnect P901 from J901.

c. Disconnect P902 from J902.

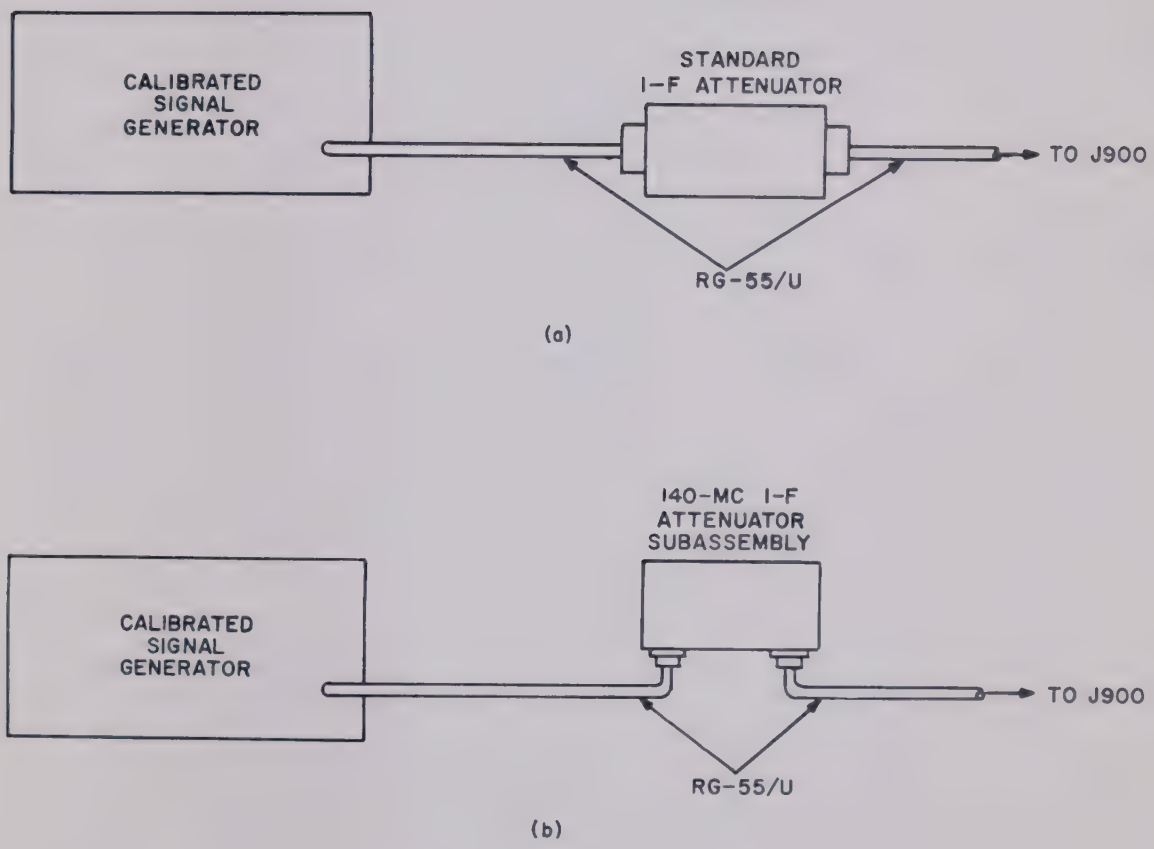


Figure 4-18. 140-Mc I-f Attenuator Alignment, Equipment Set Up

d. Disconnect P903 from J903.

e. Disconnect P904 from J904.

f. Loosen and remove the four screws that secure the 140/40-mc i-f amplifier subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

g. Disconnect P905 from J105 and remove the subassembly from the Basic Unit.

h. Loosen and remove the four screws that secure the mounting plate to the 140/40-mc i-f amplifier chassis. Again, place the screws and their associated hardware in an accessible location.

i. Remove the mounting plate from the 140/40-mc i-f amplifier chassis. The individual components that constitute the chassis will now be visible and accessible.

4-39. A defect within the 140/40-mc i-f amplifier can be found by use of the component location diagram supplied in figure 4-19, the voltage and resistance measurements supplied in table 4-8, and the schematic diagram of the subassembly supplied in figure 5-5.

NOTE:

When making voltage and resistance measurements, be sure to connect P905 to J105, thereby coupling the 140/40-mc i-f amplifier to the remainder of the FIM-2 system.

4-40. 140/40-MC I-F AMPLIFIER, ALIGNMENT.

4-41. 40-MC STAGES. To align the 40-mc stages of the 140/40-mc i-f amplifier subassembly, proceed as outlined in the following steps.

a. With a d-c vtvm connected between TP359 and chassis ground (positive probe connected to TP359), adjust Scale Tracking control R359 to obtain a vtvm pointer deflection of 0 volts.

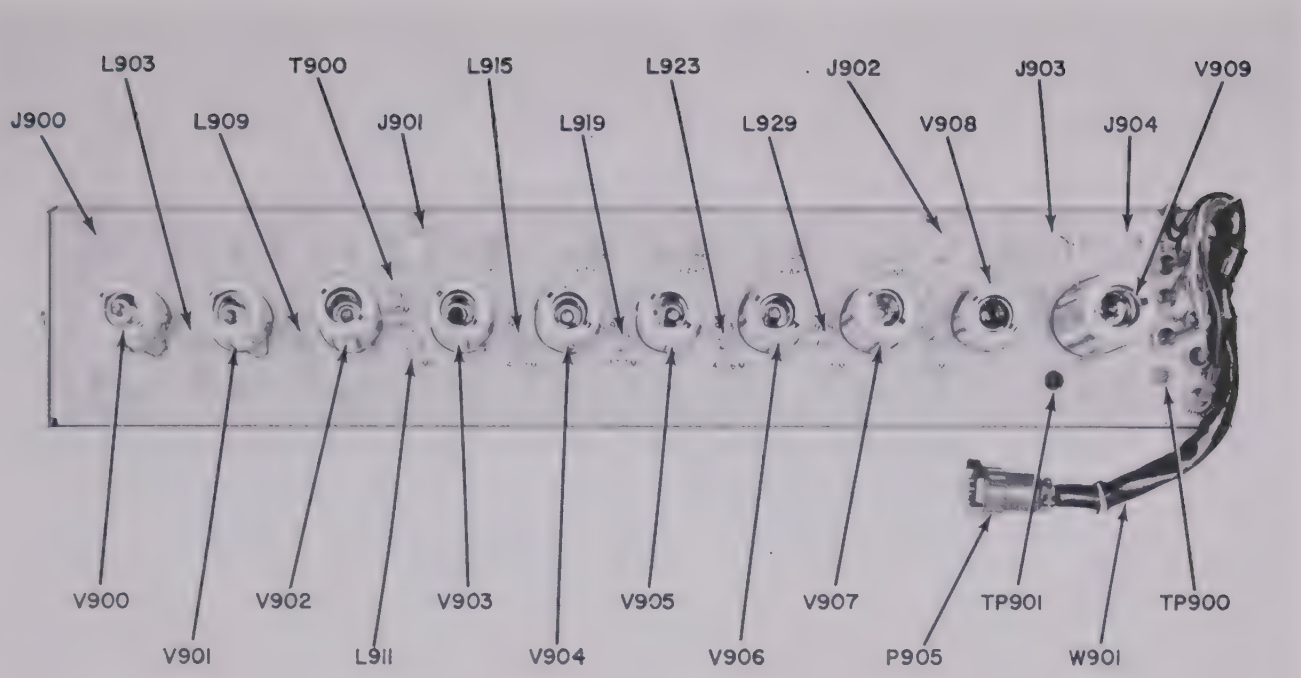


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram (Sheet 1 of 5)

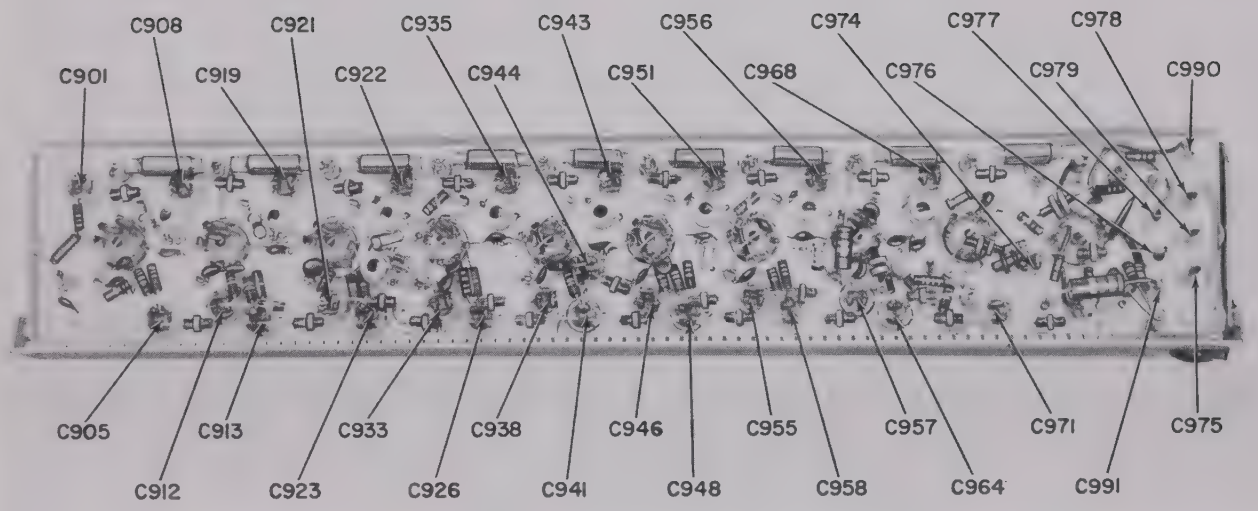


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram
(Sheet 2 of 5)

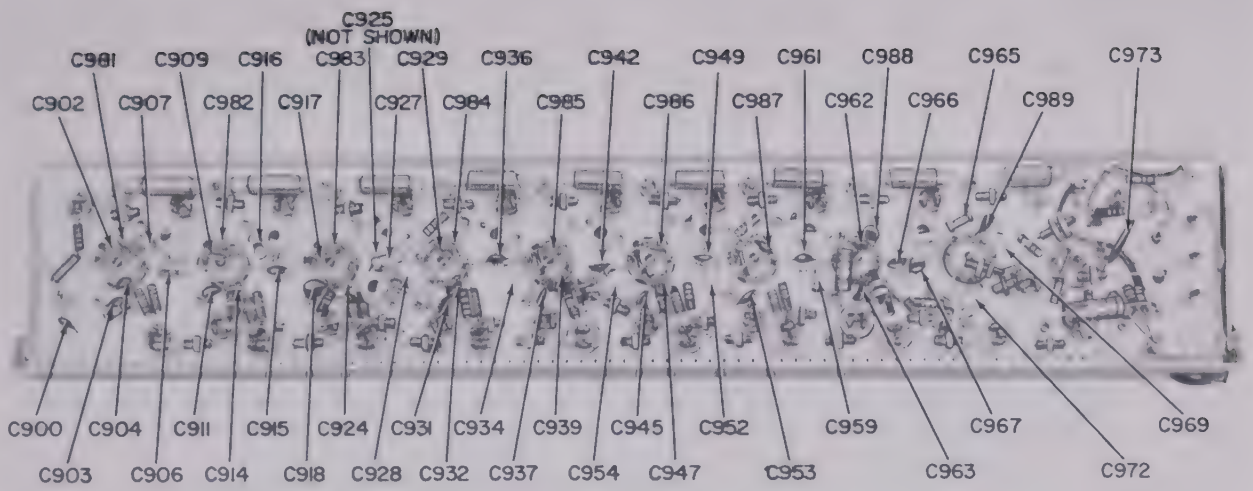


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram
(Sheet 3 of 5)

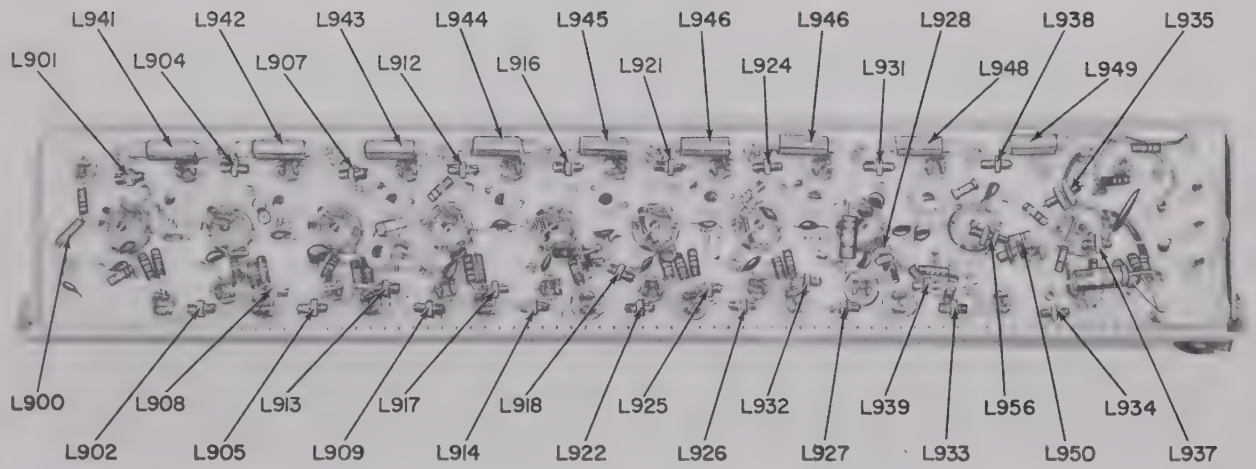


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram (Sheet 4 of 5)

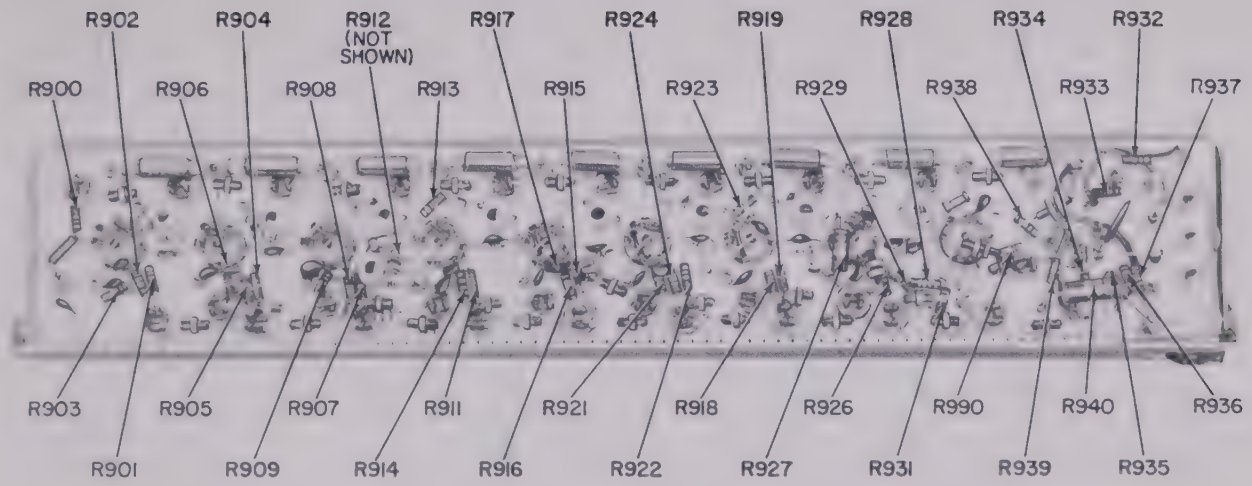


Figure 4-19. 140/40-Mc I-f Amplifier, Component Location Diagram (Sheet 5 of 5)

Table 4-8. 140/40-Mc I-f Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV900	6AK5	+0.95 290K	+2.3 220	6.3AC 0.2	0 0	+105 9K	+80 22K	+2.3 220			Volts Ohms
XV901[3]	6AK5	0 0	+1.6 220	6.3AC 0.2	0 0	+105 9K	+95 23K	+1.6 220			Volts Ohms
XV902[3]	6AK5	0 0	+1.5 220	6.3AC 0.2	0 0	+115 8K	+95 24K	+1.5 220			Volts Ohms
XV903	6AK5	0 0	+1.6 380	6.3AC 0.2	0 0	+115 8K	+85 42K	+1.6 380			Volts Ohms
XV904	6AK5	+0.95 290K	+2.5 220	6.3AC 0.2	0 0	+105 8K	+100 18K	+2.5 220			Volts Ohms
XV905	6AK5	+0.95 290K	+2.5 220	6.3AC 0.2	0 0	+100 8K	+95 18K	+2.5 220			Volts Ohms
XV906	6AK5	0 0	+1.8 180	6.3AC 0.2	0 0	+105 8K	+125 6K	+1.8 180			Volts Ohms
XV907	6AN5	0 0	+5.6 150	6.3AC 0.2	0 0	+125 7K	+125 7K	+5.6 150			Volts Ohms
XV908	6AL5	+1.1 600	0 0	6.3AC 0.2	0 0	+47 2K	NC	-50 5K			Volts Ohms
XV909	5687	+125 7K	0 5K	+2.5 22K	6.3AC 0.2	6.3AC 0.2	+10 750	+0.25 600K	0 0	+125 7K	Volts

NOTES: 1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. IF GAIN control rotated fully clockwise.

b. With the d-c vtvm connected between TP358 and chassis ground (positive probe connected to TP358), adjust Average Low Set control R362 to obtain a vtvm pointer deflection of 0.75 volts.

c. Set the OUTPUT switch to ZERO SET.

d. Connect the d-c vtvm between TP900 and chassis ground (positive probe connected to TP900).

e. Connect a calibrated signal generator, tuned to 40 mc and adjusted to obtain a convenient reference deflection on the vtvm, to coaxial input jack J901.

f. Adjust tunable transformer T901 to obtain maximum deflection of the vtvm pointer.

g. Repeat step e, above, for calibrated signal generator frequencies listed below in table 4-9 (the output level being adjusted for a convenient reference deflection), adjusting the indicated controls to peak the deflection of the vtvm pointer.

TABLE 4-9. TUNING SEQUENCE, 40-MC STAGES.

Step	Generator Frequency	Tune Variable Inductor
1	37.5 mc	L929
2	42.6 mc	L923
3	37.7 mc	L919
4	42.3 mc	L915

h. After satisfactory peaking indications have been obtained, connect P901 to J901 and proceed to paragraph 4-42.

4-42. 140-MC STAGES. To align the 140-mc stages of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. Connect the calibrated signal generator, tuned to 140-mc, to coaxial input jack J900.

b. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of approximately 5 volts.

c. Adjust tunable transformer T900 to obtain maximum deflection of the vtvm pointer.

d. Adjust variable inductor L911 to peak the deflection of the vtvm pointer.

e. Tune the calibrated signal generator to 137 mc.

f. Adjust variable inductor L906 to obtain maximum deflection of the vtvm pointer.

g. Tune the calibrated signal generator to 143 mc.

h. Adjust variable inductor L903 to obtain maximum deflection of the vtvm pointer.

i. After satisfactory peaking of the 140/40-mc i-f amplifier has been completed, proceed to paragraphs 4-43 and 4-44, in sequence, to check the sensitivity and bandwidth, respectively, of the subassembly.

4-43. SENSITIVITY CHECK. To check the sensitivity of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. Tune the calibrated signal generator to 140 mc and adjust for minimum output level.

b. Adjust the IF GAIN control to obtain a vtvm pointer deflection of 1 volt. This corresponds to the noise level of the subassembly.

c. Adjust the output level of the calibrated signal generator to obtain a vtvm pointer deflection of 1.41 volts, which corresponds to signal plus noise being equal to twice the noise. The amplitude of the 140-mc signal necessary to produce this indication

should be no greater than 4 microvolts.

4-44. BANDWIDTH CHECK. To check the bandwidth of the 140/40-mc i-f amplifier, proceed as outlined in the following steps.

a. Adjust the IF GAIN control to a front-panel indication of 6.

b. Adjust the output level of the calibrated signal generator, which is still tuned to 140 mc, to obtain a vtvm pointer deflection of 10 volts.

c. Detune the calibrated signal generator, maintaining its output level constant, to obtain the upper and lower 3-db points (vtvm pointer indication of 7.07 volts). A 3-db bandwidth of approximately 4.5 mc indicates satisfactory operation.

d. Repeat step c, above, to obtain the upper and lower 6-db points (vtvm pointer deflection of 5 volts). A 6-db bandwidth of between 5.5 and 6.0 mc indicates satisfactory operation.

4-46. AUDIO-METERING CHASSIS, TROUBLESHOOTING.

4-47. A defect within the audio-metering chassis can be localized through the component location diagram supplied in figure 4-20, the voltage and resistance measurements supplied in table 4-10, and the schematic diagram of the subassembly supplied in figure 5-5.

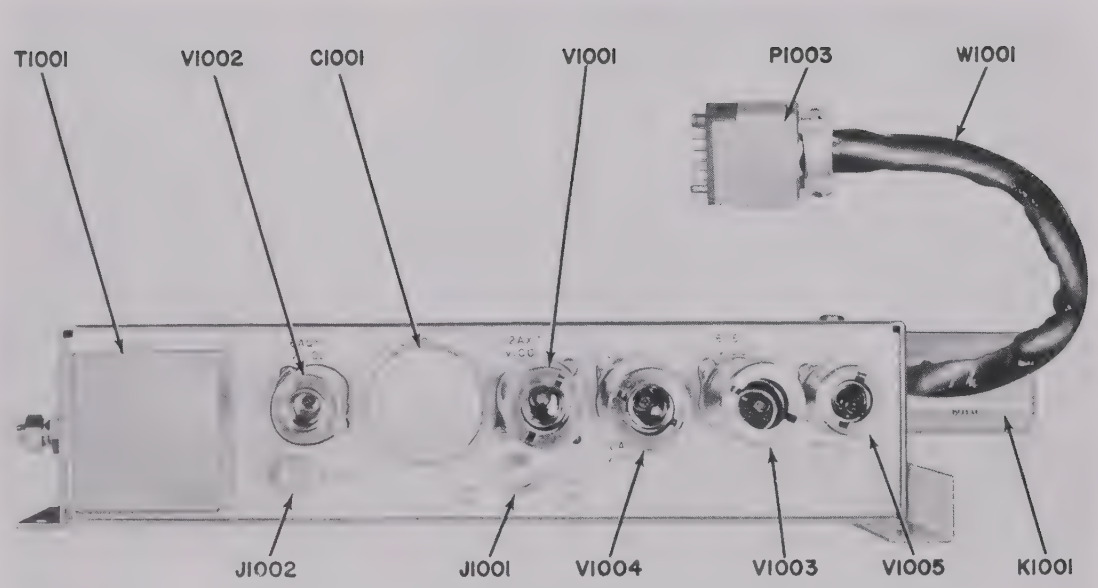


Figure 4-20. Audio-Metering Chassis, Component Location Diagram
(Sheet 1 of 2)

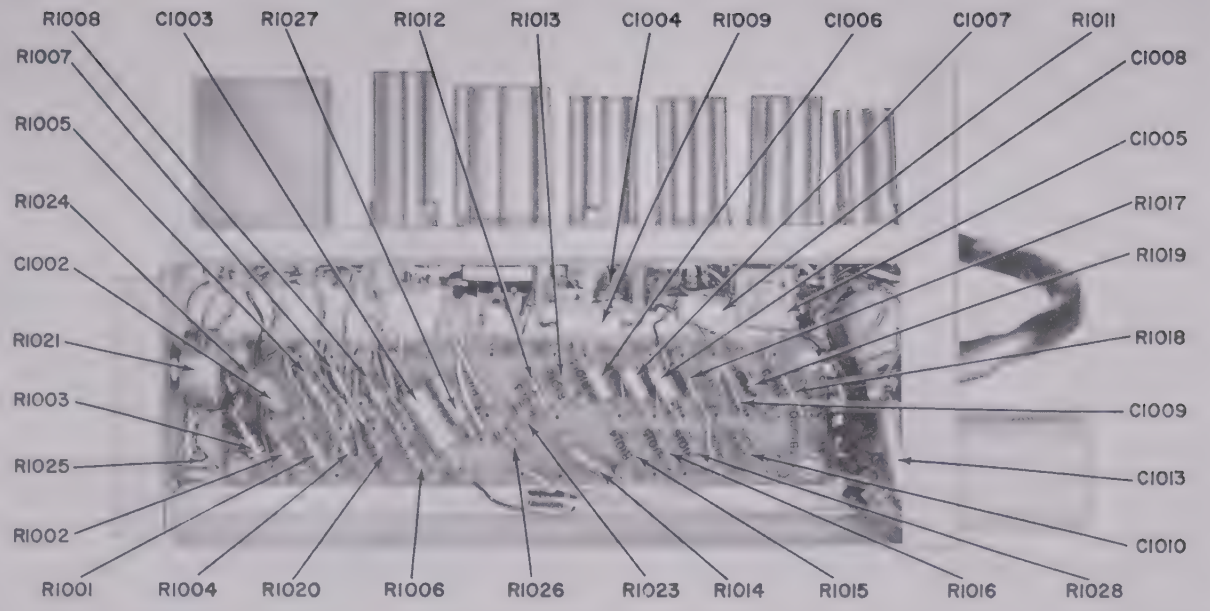


Figure 4-20. Audio-Metering Chassis, Component Location Diagram (Sheet 2 of 2)

Table 4-10. Audio-Metering Chassis, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number									
		1	2	3	4	5	6	7	8	9	
XV1001	12AX7	+105	0	0	0	0	+125	0	+1.3	-6.3	Volts
		55	Inf	220	0	0	290K	750K	240K	0	Ohms
XV1002	6AQ5	0	+6	0	-6.3	+105	+110	0			Volts
		450K	400	0	0	8K	8K	450K			Ohms
XV1003	6U8	+125	0	0	0	-6.3	0	0	+4	+0.9	Volts
		290K	Inf	Inf	0	0	Inf	750K	3.2K	270K	Ohms
XV1004[4]	12AT7	+125	+20	+25	0	0	+125	+20	+26	-6.3	Volts
		6.5K	450K	5K	0	0	6.5K	450K	10K	0	Ohms
XV1005[4]	6AU6	0	+1.4	0	-6.3	+20	+34	+1.4			Volts
		125K	4.5K	0	0	450K	800K	4.5K			Ohms

NOTES:
1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. OUTPUT switch set to PEAK.
4. AURAL AID and AUDIO GAIN controls rotated fully clockwise.

4-48. WEIGHTING CIRCUITRY, TROUBLESHOOTING.

4-49. To troubleshoot the weighting circuitry, check the components mounted on OUTPUT switch S301, using the schematic diagram of the switch and its associated circuitry that is supplied in figure 5-6. Also check the components mounted on terminal board assemblies TB300 and TB301, as shown in figures 4-21 and 4-22, respectively.

4-50. OUTPUT METER SCALE TRACKING.

4-51. Repair and/or realignment of any subassembly ahead of the output meter will necessitate retracking of the output meter to adjust the output characteristics of the i-f circuitry to the screening on the output meter panel. The controls employed in the retracking of the output meter are located on both the meter adjust board and the low-voltage power supply. To retrack the output meter, proceed as outlined in the following steps.

NOTE:

The accuracy of the output meter scale tracking procedure depends on the signal level applied to the i-f circuitry. This, in turn, depends on the sensitivity of the Tuning Unit installed in the Basic Unit. The tracking procedures listed below are based on the assumption that the Tuning Unit in use meets the minimum sensitivity specification of -81 dbm.

a. With the POWER switch set to OFF, insert a Tuning Unit into the Basic Unit.

b. Set the POWER switch to ON. Allow the FIM-2 to warm up for at least 15 minutes.

c. Connect i-f cable assembly W1204 as a jumper between the MIXER OUT and IF IN jacks.

d. Set the FUNCTION SEL switch to ZERO SET.

e. Connect r-f cable assembly W1204 as a jumper between the

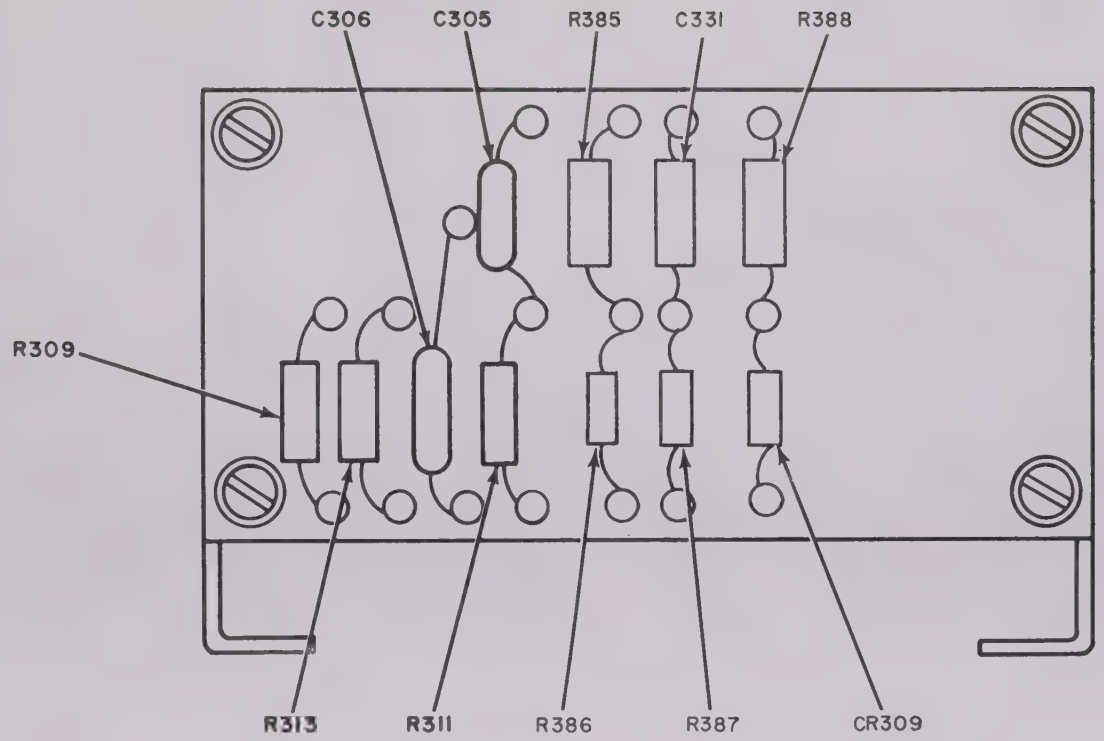


Figure 4-21. Terminal Board Assembly TB300, Component Location Diagram

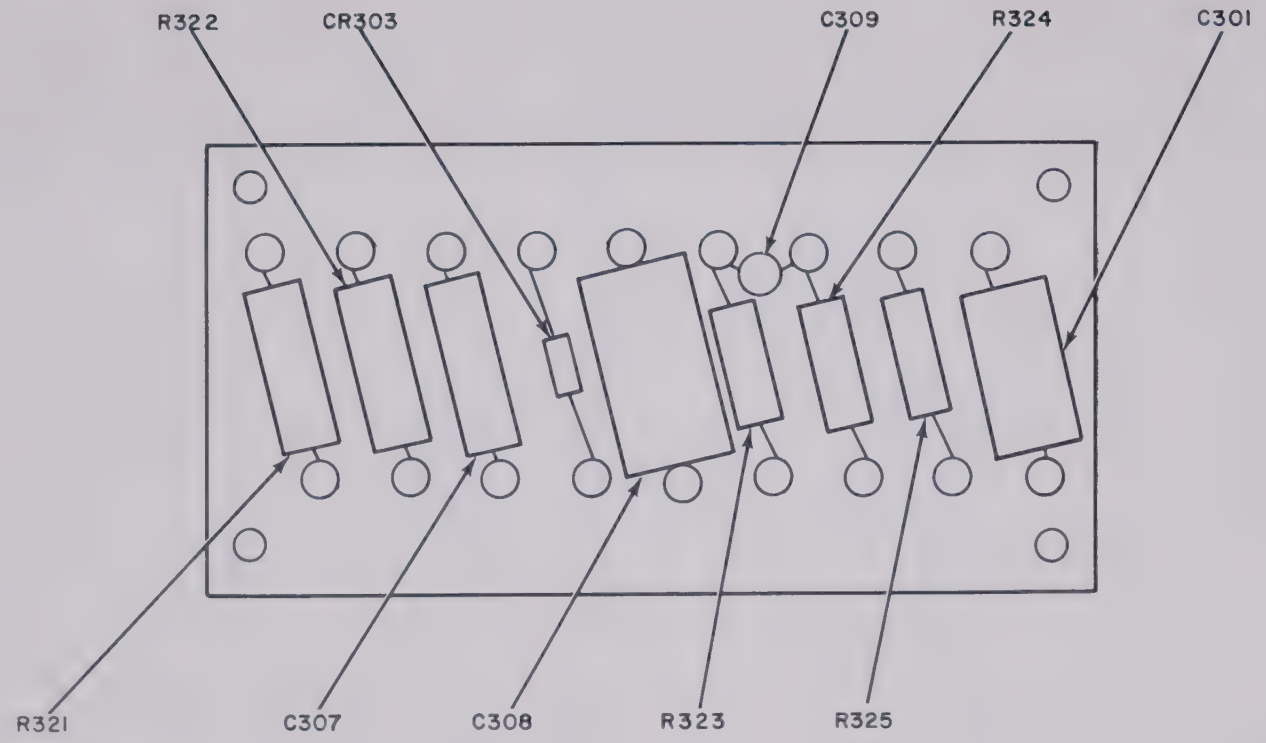


Figure 4-22. Terminal Board Assembly TB301, Component Location Diagram

SIG GEN OUT jack and the PRESEL IN jack.

f. Set the AFC switch to OUT.

g. Adjust the i-f Input Attenuator Db push-button switches so that there is no i-f attenuation inserted into the system.

h. Set the OUTPUT switch to ZERO SET.

i. Adjust the output meter ZERO SET control to zero-set the output meter.

WARNING:

Before removing a vacuum tube from its socket, first place a handkerchief over the tube shield to dissipate the heat. When the tube shield is cool to the touch, remove it and repeat the procedure for the tube.

j. Remove V906 (6AK5) from the 140/40-mc i-f amplifier sub-assembly.

k. Set the OUTPUT switch to QUASI-PEAK.

l. Adjust Meter Signal Adj control R128 to zero-set the output meter.

m. Set the OUTPUT switch to AVERAGE.

n. Adjust Avg Mtg Position control R122 to zero-set the output meter.

o. Repeat steps k through n, above, until there is no difference between zero-set indications for both the QUASI-PEAK and AVERAGE positions of the OUTPUT switch.

p. Rotate the IF GAIN control fully counterclockwise.

q. Replace V906.

r. Set the OUTPUT switch to QUASI-PEAK.

s. Adjust Q.P. Low Set control R361, if necessary, to zero-set the output meter.

t. Set the OUTPUT switch to AVERAGE.

u. Adjust Average Low Set control R362, if necessary, to

zero-set the output meter.

v. Repeat steps r through u, above, until there is no difference between the zero-set indications for both the QUASI-PEAK and AVERAGE positions of the OUTPUT switch.

w. Rotate Meter Sensitivity control R351 fully counterclockwise.

x. Rotate Scale Tracking control R368,fully clockwise.

y. Disconnect P900 from J900.

z. Connect a calibrated signal generator, tuned to 140 mc, to J900.

aa. Adjust the output level of the calibrated signal generator to 4 microvolts.

ab. Adjust the IF GAIN control to obtain an output meter pointer deflection of 10 on the RF UV scale.

ac. Adjust the output level of the calibrated signal generator to 400 microvolts.

ad. Note the output meter pointer deflection. It should deflect to an indication less than 1000 on the RF UV scale.

ae. Adjust Meter Sensitivity control R351 to obtain an output meter pointer deflection of 1000 on the RF UV scale.

af. Repeat steps aa through ae, above, until the output meter pointer deflection corresponds to 1000 on the RF UV scale when the output level of the calibrated signal generator is 400 microvolts.

ag. Disconnect the calibrated signal generator from J900.

ah. Connect P900 to J900.

ai. Rotate the TUNING control to any desired frequency, as indicated on the FREQUENCY IN KILOMEGACYCLES dial.

aj. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.

ak. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.

al. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

am. Set the FUNCTION SEL switch to CAL SIG GEN.

an. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL (0).

ao. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 65 mark on the -dbm scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

ap. Adjust the SIGNAL CALIBRATOR COARSE TUNING control to obtain maximum deflection of the output meter pointer.

aq. Adjust the SIGNAL CALIBRATOR FINE TUNING control to peak the deflection of the output meter pointer.

ar. Readjust the SIGNAL CALIBRATOR POWER SET control, if necessary, to maintain a power monitor meter pointer deflection of CAL (0).

as. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

at. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

au. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 100 mark on the microvolts scale of the -DBM MICROVOLTS dial beneath the power set indicator hairline.

av. Note the output meter pointer deflection. It should indicate 100 microvolts $\pm$ ½ db. If it does not, adjust Meter Sensitivity control R351 in such a manner as to increase the error slightly. Repeat steps as through au, above, as often as necessary to obtain an output meter pointer deflection of 1000 and 100 for SIGNAL CALIBRATOR -DBM MICROVOLTS dial indications of 1K and 100 microvolts, respectively.

aw. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 30 mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

ax. Note the output meter pointer deflection. It should deflect to an indication of 30 microvolts $\pm \frac{1}{2}$ db on the RF UV scale.

NOTE:

Do not alter either the output level of the signal calibrator or the setting of the IF GAIN control from this point until the end of the procedure UNLESS SPECIFICALLY INSTRUCTED TO DO SO. The three other positions of the OUTPUT switch, namely QUASI-PEAK, PEAK, and SLIDEBACK, will be set about the AVERAGE position of the OUTPUT switch.

ay. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

az. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

ba. Set the OUTPUT switch to QUASI-PEAK.

bb. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts $\begin{matrix} +\ 0\ \text{db} \\ -\ 1\ \text{db} \end{matrix}$.

bc. Set the OUTPUT switch to AVERAGE.

bd. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

be. Set the OUTPUT switch to QUASI-PEAK.

bf. Note the output meter pointer deflection. It should deflect to an indication of 200 microvolts $\begin{matrix} +\ 0\ \text{db} \\ -\ 1\ \text{db} \end{matrix}$. If it does not, adjust Q.P. Low Set control R361 to obtain an output meter pointer

deflection within the above limits.

bg. Set the OUTPUT switch to AVERAGE.

bh. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

bi. Set the OUTPUT switch to QUASI-PEAK.

bj. Note the output meter pointer deflection. It should deflect to an indication of 100 microvolts $\pm \frac{1}{2}$ db. If it does not, repeat steps ay through bi, above, until the limits specified in steps bb,bf, and bj are obtained.

bk. Set the OUTPUT switch to AVERAGE.

bl. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

bm. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

bn. Set the OUTPUT switch to PEAK.

bo. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts $^{+\ 0\ db}_{-\ 1\ db}$.

bp. Set the OUTPUT switch to AVERAGE.

bq, Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

br. Set the OUTPUT switch to PEAK.

bs. Note the output meter pointer deflection. It should deflect to an indication of 200 microvolts $^{+\ 0\ db}_{-\ 1\ db}$. If it does not, adjust Peak Low Set control R354 to obtain an output meter pointer

deflection within the above limits.

bt. Set the OUTPUT switch to AVERAGE.

bu. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

bv. Set the OUTPUT switch to PEAK.

bw. Note the output meter pointer deflection. It should deflect to an indication of 100 microvolts $\pm \frac{1}{2}$ db. If it does not, repeat steps bl through bv, above, until the limits specified in steps bo, bs, and bw are obtained.

bx. Set the OUTPUT switch to AVERAGE.

by. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 1K mark on the microvolts scale of the SIGNAL CALIBRATOR -DBM MICROVOLTS dial directly beneath the power set indicator hairline.

bz. Adjust the IF GAIN control to obtain an output meter pointer deflection of 1000 on the RF UV scale.

ca. Set the OUTPUT switch to PEAK.

cb. Note the output meter pointer deflection. It should deflect to an indication of 1000 microvolts $\begin{matrix} + 0 \text{ db} \\ - 1 \text{ db} \end{matrix}$.

cc. Plug a 600-ohm headset into the AUDIO OUT jack.

cd. Rotate the SLIDEBACK control fully clockwise.

ce. Adjust the AUDIO GAIN control to a front-panel indication of 5.

cf. Connect a square-wave generator, adjusted for 1000-cps at 50 volts peak-to-peak, to the EXT MOD jack.

cg. Place the headset over ears.

ch. Note the noise obtained from the headset.

ci. Rotate the SLIDEBACK control counterclockwise until the 1,000-pps modulation signal just emerges from the noise.

cj. Note the output meter pointer deflection. It should deflect to the same indication as in step cb.

ck. Rotate the SLIDEBACK control fully clockwise.

cl. Remove the headset from ears.

cm. Set the OUTPUT switch to PEAK.

cn. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 200 on the RF UV scale.

co. Set the OUTPUT switch to SLIDEBACK.

cp. Place the headset over ears.

cq. Note the noise obtained from the headset.

cr. Rotate the SLIDEBACK control counterclockwise until the 1,000-pps modulation signal just emerges from the noise.

cs. Note the output meter pointer deflection. It should deflect to an indication obtained in step cn. If it does not, adjust Slbk Low Set control R359 to obtain an output meter pointer deflection specified above.

ct. Rotate the SLIDEBACK control fully clockwise.

cu. Remove the headset from ears.

cv. Set the OUTPUT switch to PEAK.

cw. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 100 on the RF UV scale.

cx. Set the OUTPUT switch to SLIDEBACK.

cy. Place the headset over ears.

cz. Note the noise obtained in the headset.

da. Rotate the SLIDEBACK control counterclockwise until the 1,000-cps modulation signal just emerges from the noise.

db. Note the output meter pointer deflection. It should be the same as in step cw. If it does not, repeat steps bx through da, above, until the limits specified in steps cj, cs, and db are obtained.

4-52. AFC-I-F AMPLIFIER, TROUBLESHOOTING.

4-53. To remove the afc-i-f amplifier from the Basic Unit for troubleshooting and effecting the necessary repairs, proceed as outlined in the following steps.

a. Disconnect P1050 from J1050.

WARNING:

THE OUTPUT OF THE AFC-I-F AMPLIFIER SUBASSEMBLY IS SUPERIMPOSED UPON THE REFLECTOR SUPPLY VOLTAGE. BE SURE TO REMOVE THE REFLECTOR VOLTAGE FROM THE SUBASSEMBLY BY DISCONNECTING P1051 FROM J104.

b. Disconnect P1051 from J104.

c. Disconnect P1052 from J101.

d. Loosen and remove the four screws that secure the subassembly to the Basic Unit frame. Place the screws and their associated hardware in an accessible location.

e. Remove the afc-i-f amplifier subassembly from the Basic Unit.

f. Loosen and remove the four screws that secure the mount-

ing plate to the afc-i-f amplifier chassis. Again, place the screws and their associated hardware in an accessible location.

g. Remove the mounting plate from the afc-i-f amplifier subassembly. The individual components that constitute the subassembly will now be both visible and accessible.

4-54. A defect within the afc-i-f amplifier can be located through the component location diagram supplied in figure 4-23, the voltage and resistance measurements supplied in table 4-11, and the schematic diagram of the subassembly supplied in figure 5-5.

4-55. AFC-I-F AMPLIFIER, ALIGNMENT.

4-56. To align the afc-i-f amplifier, connect P1052 to J101, and proceed as outlined in the following steps.

a. Connect a calibrated signal generator, tuned to 40 mc and adjusted for an output level of 50,000 microvolts, to coaxial input jack J1050.

b. Connect the a-c probe of a vtvm to V1051, pin 1. Connect the common probe to chassis ground.

c. Adjust variable inductor L1050 to obtain maximum deflection of the vtvm pointer.

d. Connect the a-c probe of the vtvm to V1052, pin 1. The common probe should remain connected to chassis ground.

e. Adjust variable inductor L1052 to obtain maximum deflection of the vtvm pointer.

f. Connect the a-c probe of the vtvm to V1053, pin 1. The common probe should remain connected to chassis ground.

g. Adjust variable inductor L1054 to obtain maximum deflection of the vtvm pointer.

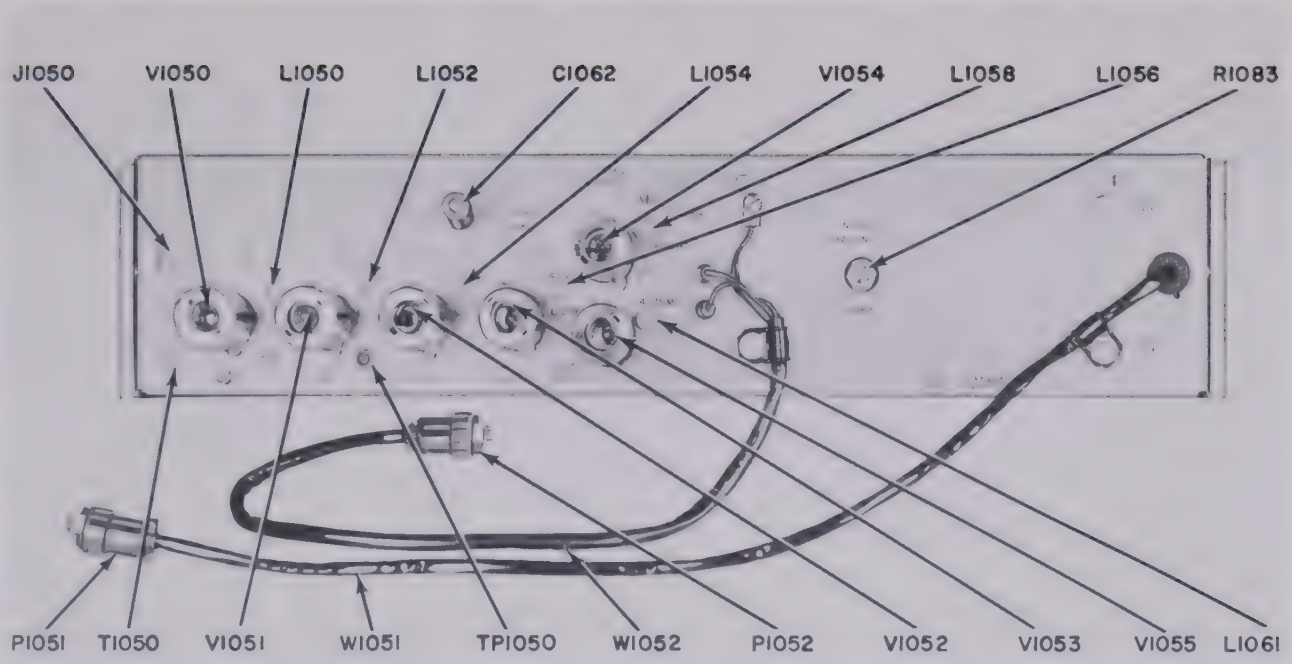


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 1 of 4)

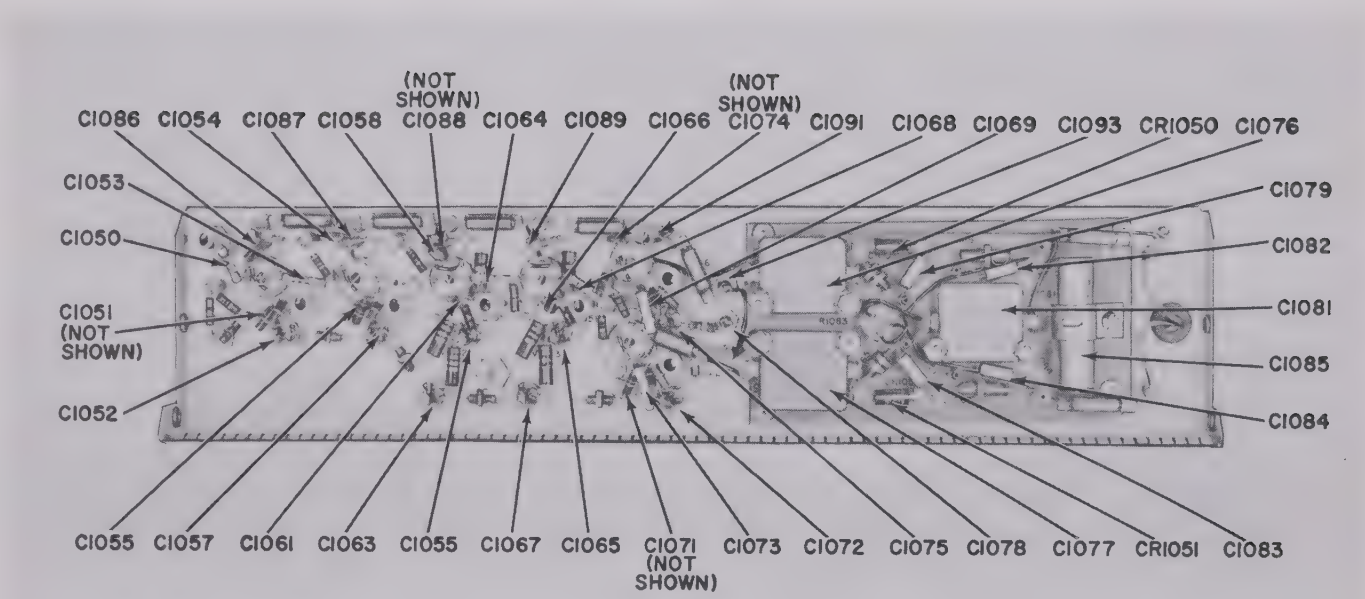


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 2 of 4)

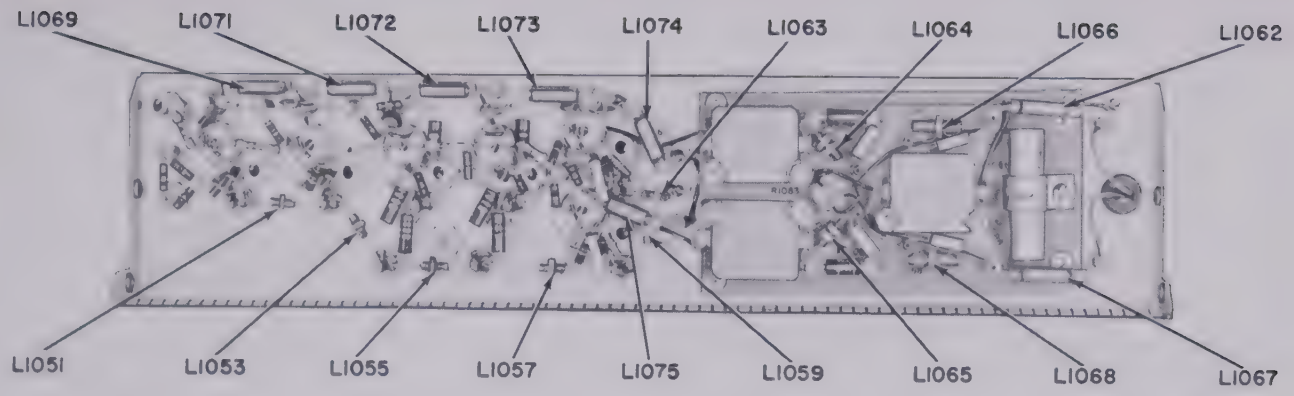


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 3 of 4)

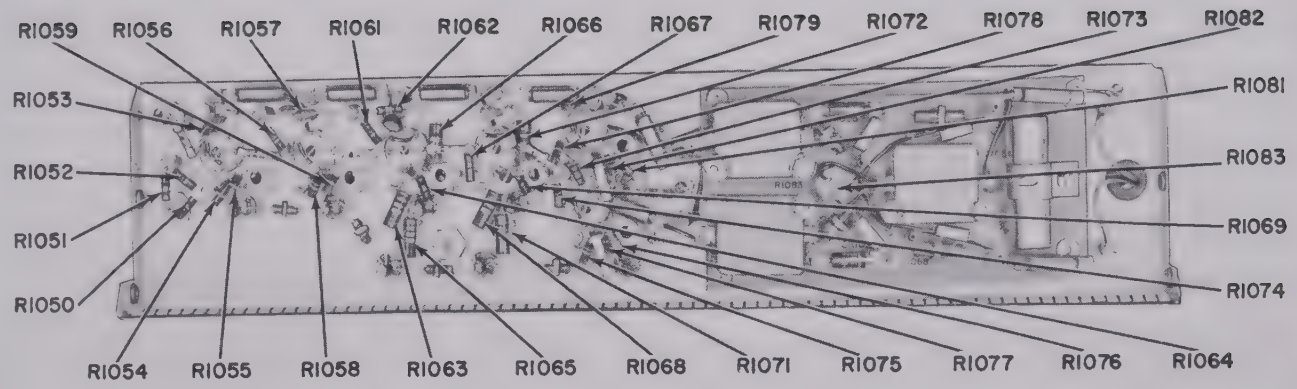


Figure 4-23. Afc-I-f Amplifier, Component Location Diagram
(Sheet 4 of 4)

Table 4-11. Afc-I-f Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Number							
		1	2	3	4	5	6	7	
XV1050	6AU6	0	+1.15	6.3AC	0	+125	+125	+1.15	Volts
		2.2K	100	0.2	0	6.8K	6.8K	100	Ohms
XV1051	6AU6	0	+1.2	6.3AC	0	+125	+125	+1.2	Volts
		5.5K	100	0.2	0	6.5K	6.5K	100	Ohms
XV1052	6AK5	-0.1	0	6.3AC	0	+13.5	+42.5	0	Volts
		12K	0	0.2	0	34K	8.5K	0	Ohms
XV1053	6AK5	-0.1	0	6.3AC	0	+16.5	+44	0	Volts
		15K	0	0.2	0	34K	8.5K	0	Ohms
XV1054	6AU6	0	+1.15	0	6.3AC	+125	+125	+1.15	Volts
		4.7K	100	0	0.2	6.5K	6.5K	100	Ohms
XV1055	6AU6	0	+1.15	0	6.3AC	+125	+125	+1.15	Volts
		4.7K	100	0	0.2	6.5K	6.5K	100	Ohms

NOTES: 1. Voltage readings taken with a 20,000 ohm/volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. Voltage readings taken with P1051 removed from J104.

h. Connect the a-c probe of the vtvm at the junction of resistors R1074 and R1078. The common probe should remain connected to chassis ground.

i. Adjust variable inductor L1056 to obtain maximum deflection of the vtvm pointer.

j. Adjust Noise Balance control R1083 to mid-position.

k. Adjust the calibrated signal generator for an output of 50,000 microvolts at 41.75 mc.

l. Connect the positive probe of the vtvm, which has been adjusted for +dc, to pin A of P1051. The common probe should be connected to pin D.

m. Adjust variable inductor L1061 to obtain maximum deflection of the vtvm pointer.

n. Adjust the calibrated signal generator for 50,000 microvolts at 38.25 mc.

o. Set the vtvm for -dc.

p. Adjust variable inductor L1058 to obtain maximum deflection of the vtvm pointer.

q. Adjust the calibrated signal generator for a 50,000 microvolt output at 40 mc.

r. Adjust Noise Balance control R1083 to obtain a vtvm pointer deflection of 0 volts.

s. Vary the output frequency of the calibrated signal generator over the range from 38.25 mc to 41.75 mc, maintaining its output level constant at 50,000 microvolts. With the vtvm, adjusted for +dc, connected to P1051, the d-c error signal output as a function of frequency shown in figure 4-24 should be obtained.

NOTE:

Zero volts should fall at the 40-mc mark, and the values of +3.5 volts (± 0.25 volts) and -3.5 volts (± 0.25 volt) should fall at 41.75 and 38.25 mc, respectively. If the above values cannot be obtained, V1054, V1055, and/or CR1050 and CR1051 should be replaced and the entire afc-i-f amplifier alignment procedure repeated.

4-57. After the afc-i-f amplifier has been aligned and is operating properly, replace it into the Basic Unit by following both the reverse procedure and sequence of paragraph 4-52, steps a through g.

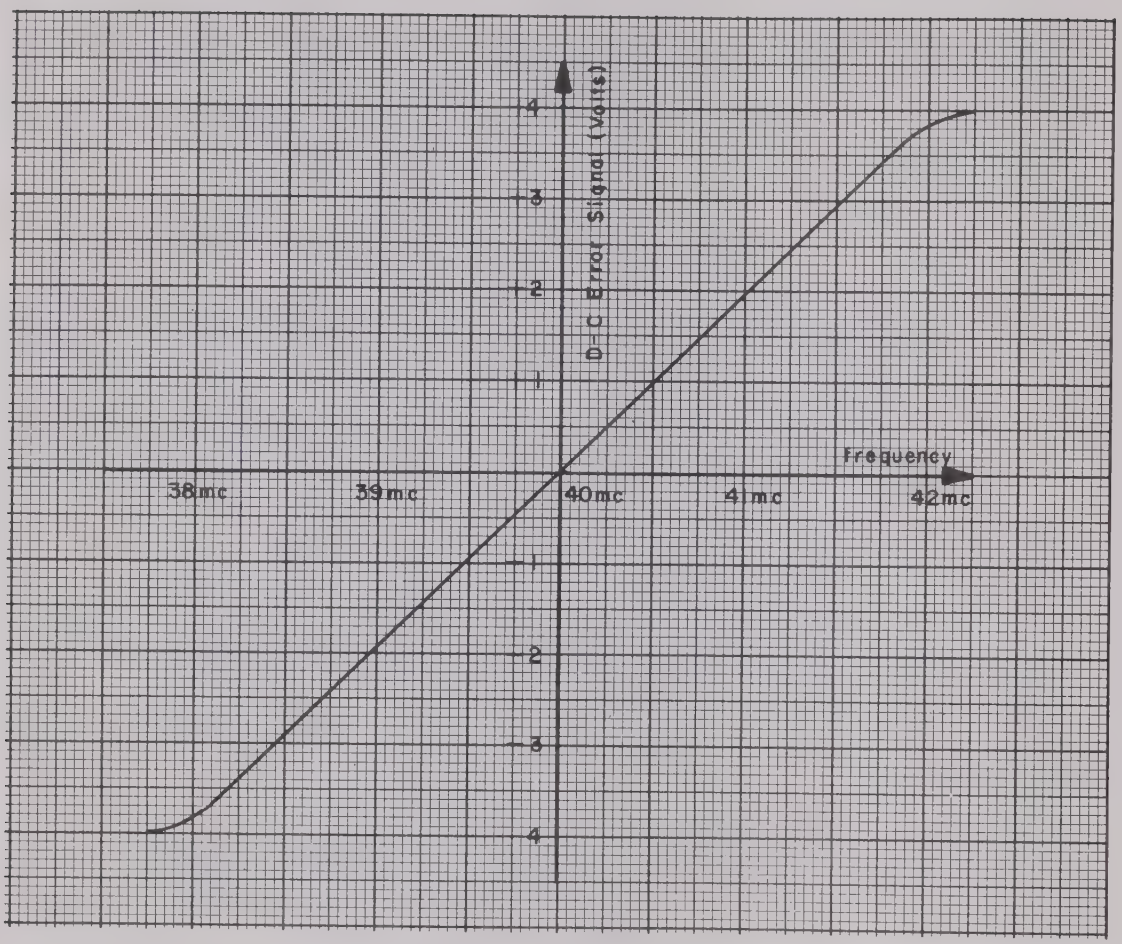


Figure 4-24. Afc-I-f Amplifier D-c Error Signal Output as a Function of Input Frequency

4-58. AFC AMPLIFIER, TROUBLESHOOTING.

4-59. To determine if the afc amplifier is operating properly, proceed as outlined in paragraph 2-7, steps a through al. Then proceed as outlined in the following steps.

a. With the AFC switch still in the OUT position, detune the microwave signal generator 5 mc either side of the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

b. Note the output meter pointer deflection. It should decrease.

c. Set the AFC switch to IN.

d. Note the output meter pointer deflection. It should be the same as that of paragraph 2-7, step al. If it is not, the afc amplifier, located in the high-voltage power supply, is defective. A defect within the afc amplifier circuitry can be localized with the aid of the voltage and resistance measurements supplied in table 4-12, the component location diagrams of the high-voltage power supply supplied in figures 4-5 through 4-8, and the schematic diagram of the high-voltage power supply supplied in figure 5-7.

4-60. AFC AMPLIFIER, ALIGNMENT.

4-61. To align the afc amplifier, proceed as outlined in the following steps.

a. With the POWER switch set to OFF, remove the Tuning Unit from the Basic Unit.

b. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit.

c. Set the AFC switch to OUT.

Table 4-12. Afc Amplifier, Voltage and Resistance Measurements

Socket	Tube Type	Pin Numbers							
		1	2	3	4	5	6	7	
XV209[3,6]	6AH6	-1100 Inf.	-1150 Inf.	-1150 Inf.	-1150 Inf.	-1100 Inf.	-900 80K	-1150 Inf.	Volts Ohms
XV209[4,6]	6AH6	-1650 Inf.	-1680 Inf.	-1680 Inf.	-1680 Inf.	-1650 Inf.	-1550 110K	-1680 Inf.	Volts Ohms
XV209[5,6]	6AH6	-1900 Inf.	-1950 Inf.	-1950 Inf.	-1950 Inf.	-1900 Inf.	-1800 135K	-1950 Inf.	Volts Ohms

Notes:

1. Voltage readings taken with a 20,000 ohm-per-volt VOM between pin and ground.
2. Resistance readings taken with power cable removed.
3. FIM-L2 or FIM-S2 Tuning Unit in use.
4. FIM-M2 Tuning Unit in use.
5. FIM-X2 Tuning Unit in use.
6. AFC switch set to IN.

d. Disconnect the jumper between pins 5 and 6 of terminal board assembly TB401, TB501, TB601, or TB701 (depending on the Tuning Unit in use).

e. Connect the positive probe of a d-c milliammeter to pin 5 of the terminal board assembly. Connect the common probe to pin 6.

f. Adjust the milliammeter for 10 ma full-scale deflection.

g. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.

h. Rotate the TUNING control to the low end of the band.

i. Adjust Low I Adjust control R424 or R743 (for the Models FIM-L2 or FIM-X2 Tuning Units, respectively) or I Adjust control R524 or R624 (for the Models FIM-S2 or FIM-M2 Tuning Units, respectively) to obtain a milliammeter pointer deflection of 7 ma.

NOTE:

Repeat the above for the TUNING control rotated to the high end of the band (for the Models FIM-L2 and FIM-X2 Tuning Units only), adjusting High I Adjust control R425 or R766, respectively, to obtain a milliammeter deflection of 7 ma.

j. Set the POWER switch to OFF.

k. Remove the milliammeter and replace the jumper between pins 5 and 6 of the terminal board assembly.

l. Set the POWER switch to ON. Allow the FIM-2 to stabilize.

m. Set Test Selector switch S351 to L.O. Refl.

n. Note the deflection of the power monitor meter pointer. It should deflect to an indication within the green region of the scale.

o. Set the AFC switch to IN.

p. Note the power monitor meter pointer deflection. It should remain at an indication within the green region of the scale. If it does not, adjust Afc Adjust control R251 to obtain the exact deflection as in step n, above.

4-62. LOCALIZING R-F TROUBLE TO AN INDIVIDUAL SUBASSEMBLY.

4-63. If the results of paragraph 4-12 indicated that the trouble lies in the r-f circuitry, proceed as outlined in table 4-13 to localize the r-f trouble to an individual r-f subassembly within either the Basic Unit or the Tuning Unit. Figure 4-25 will be of aid in locating the Tuning Unit subassemblies, components, and cables, while figures 4-10 and 4-11 will aid in locating the Basic Unit subassemblies, components, and cables.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
1	Visual	None	Set FUNCTION SEL switch to OPERATE. Connect i-f cable assembly W1204 between MIXER OUT and IF IN jacks. Set Test Selector switch S351 to Xtal Cur. Rotate TUNING control throughout band.	Power monitor meter pointer deflects smoothly over scale as TUNING control is rotated throughout the band.	First crystal mixer and first local oscillator are functioning properly. Proceed to step 2.	First crystal mixer defective. Refer to paragraph 4-59. First local oscillator defective. Refer to paragraph 4-61. Low-pass filter FL-402 (Model FIM-L2 Tuning Unit only) defective. Refer to paragraph 4-98.
2	Visual	None	Set Test Selector switch S351 to Operate. Set FUNCTION SEL switch to ZERO SET. Adjust power monitor meter ZERO SET control to obtain power monitor meter pointer indication of ZERO.	Power monitor meter pointer deflects to an indication of ZERO.	Signal calibrator power set probe and thermistor bridge functioning properly. Proceed to step 3.	Signal calibrator thermistor probe and/or thermistor bridge defective. Refer to paragraph 4-74.
3	Visual	None	Set FUNCTION SEL switch to CAL SIG GEN. Adjust SIGNAL CALIBRATOR POWER SET control to obtain power monitor meter pointer deflection corresponding to "Cal," as indicated on correction curves supplied with the Tuning Unit under test.	Power monitor meter pointer deflects to an indication corresponding to "cal."	Signal calibrator functioning properly. Proceed to step 4.	Signal calibrator defective. Refer to paragraph 4-84.
4	Visual	Microwave signal generator	Set FUNCTION SEL switch to OPERATE. Rotate IF GAIN control fully counterclockwise. Remove all i-f attenuation. Connect the microwave signal generator, tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial and adjusted for an output of 1,000 microvolt, to the PRESEL in jack. Set the OUTPUT switch to ZERO SET.	Output meter pointer deflects to an indication of 1,000 on the RF uV scale.	Preselector functioning properly. Proceed to step 5.	Preselector not aligned. Refer to paragraph 4-92. Low-pass filter FL401 or FL501 (Model FIM-L2 or FIM-S2 Tuning Units respectively) defective. Refer to paragraph 4-98.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
4	(Cont'd)		Adjust the output meter ZERO SET control to zero-set the output meter. Set the OUTPUT switch to AVERAGE. Adjust the IF GAIN control to obtain an output meter pointer indication of 1,000 on the RF uV scale.			
5	Visual	None	Set FUNCTION SEL switch to CAL SIG GEN. Rotate SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counter-clockwise. Connect r-f cable assembly W1203 between the SIG GEN OUT and PRESEL IN jacks. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output meter pointer deflection of 1,000 on the RF uV scale.	Output meter pointer deflects to an indication of 1,000 on the RF uV scale.	Signal calibrator output attenuator probe functioning properly. Proceed to step 6.	Signal calibrator output attenuator probe defective. Refer to paragraph 4-102.
6	Visual	Microwave signal generator	Connect the microwave signal generator, tuned to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial and adjusted for an output of 1,000 microvolt, to the CAL IN jack. Connect r-f cable assembly W1203 between the ATTEN OUT and PRESEL IN jacks. Depress the r-f INPUT ATTENUATOR DB push-button switch marked 0X1.	Output meter pointer deflects to an indication of approximately 1,000 on the RF uV scale.	Coaxial r-f input attenuator assembly and coaxial r-f transfer switch functioning properly.	Coaxial r-f input attenuator assembly defective. Refer to paragraph 4-108. Coaxial r-f transfer switch defective. Refer to paragraph 4-108.
7	Visual	Microwave signal generator.	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 20x10. Adjust the microwave signal generator for an output of 10,000 microvolts.	Same as step 6.	Same as step 6. Proceed to step 8.	Same as step 6.

TABLE 4-13. R-F CIRCUITRY TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication is Normal	If Indication is Abnormal
8	Visual	Microwave signal generator	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 40x100. Adjust the microwave signal generator for an output of 100,000 microvolts.	Same as step 6.	Same as step 6.	Same as step 6
9	Visual	Microwave signal generator	Depress the r-f INPUT ATTENUATOR DB push-button switch marked 60x1000. Adjust the microwave signal generator for an output of 0.223 volts (0 dbm.)	Output meter pointer deflects to an indication of approximately 200 on the RF uV scale.	Same as step 6	Same as step 6
10	Visual	Microwave signal generator	Connect microwave signal generator to the RF IN jack. Set the FUNCTION SEL switch to OPERATE.	Same as step 9	Same as step 6	Same as step 6.

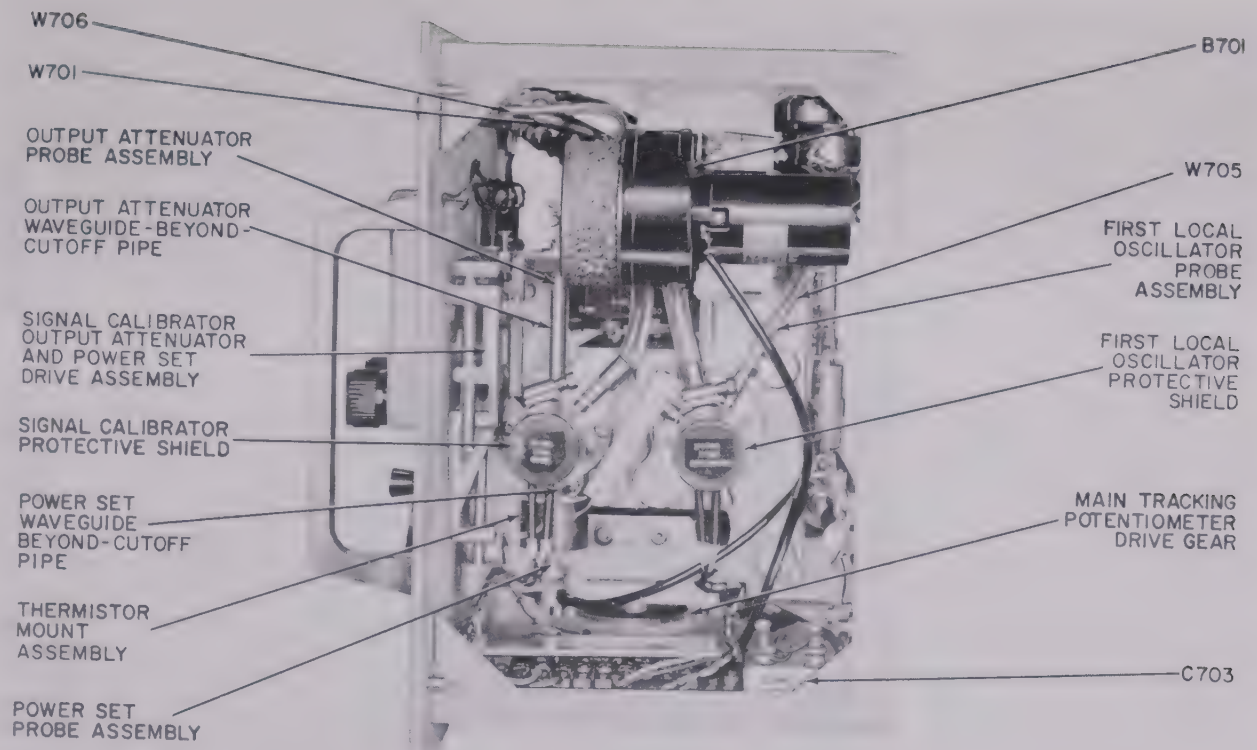


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 1 of 5)

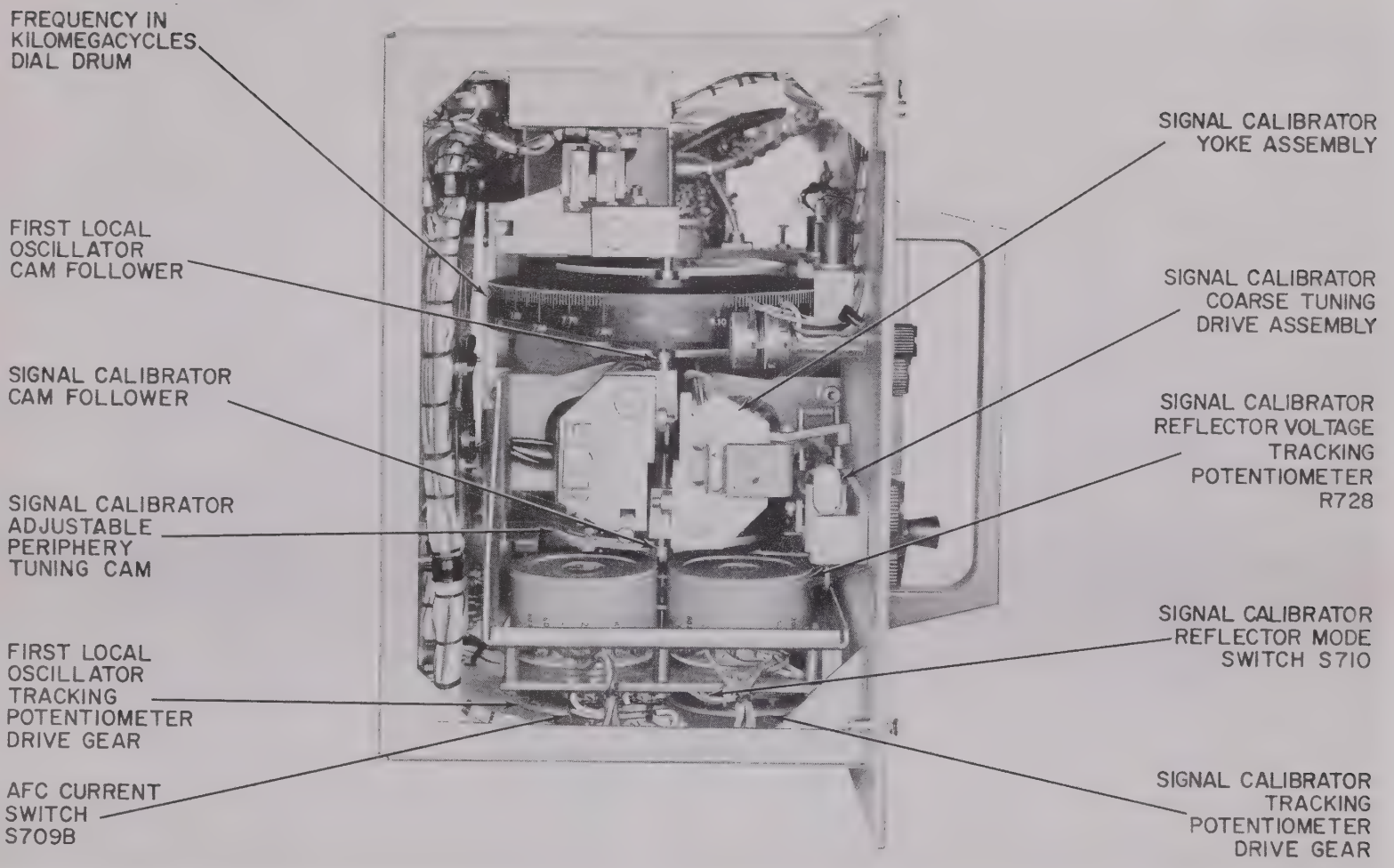

FREQUENCY IN KILOMEGACYCLES DIAL DRUM
FIRST LOCAL OSCILLATOR CAM FOLLOWER
SIGNAL CALIBRATOR CAM FOLLOWER
SIGNAL CALIBRATOR ADJUSTABLE PERIPHERY TUNING CAM
FIRST LOCAL OSCILLATOR TRACKING POTENTIOMETER DRIVE GEAR
AFC CURRENT SWITCH S709B
SIGNAL CALIBRATOR YOKE ASSEMBLY
SIGNAL CALIBRATOR COARSE TUNING DRIVE ASSEMBLY
SIGNAL CALIBRATOR REFLECTOR VOLTAGE TRACKING POTENTIOMETER R728
SIGNAL CALIBRATOR REFLECTOR MODE SWITCH S710
SIGNAL CALIBRATOR TRACKING POTENTIOMETER DRIVE GEAR

Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 2 of 5)

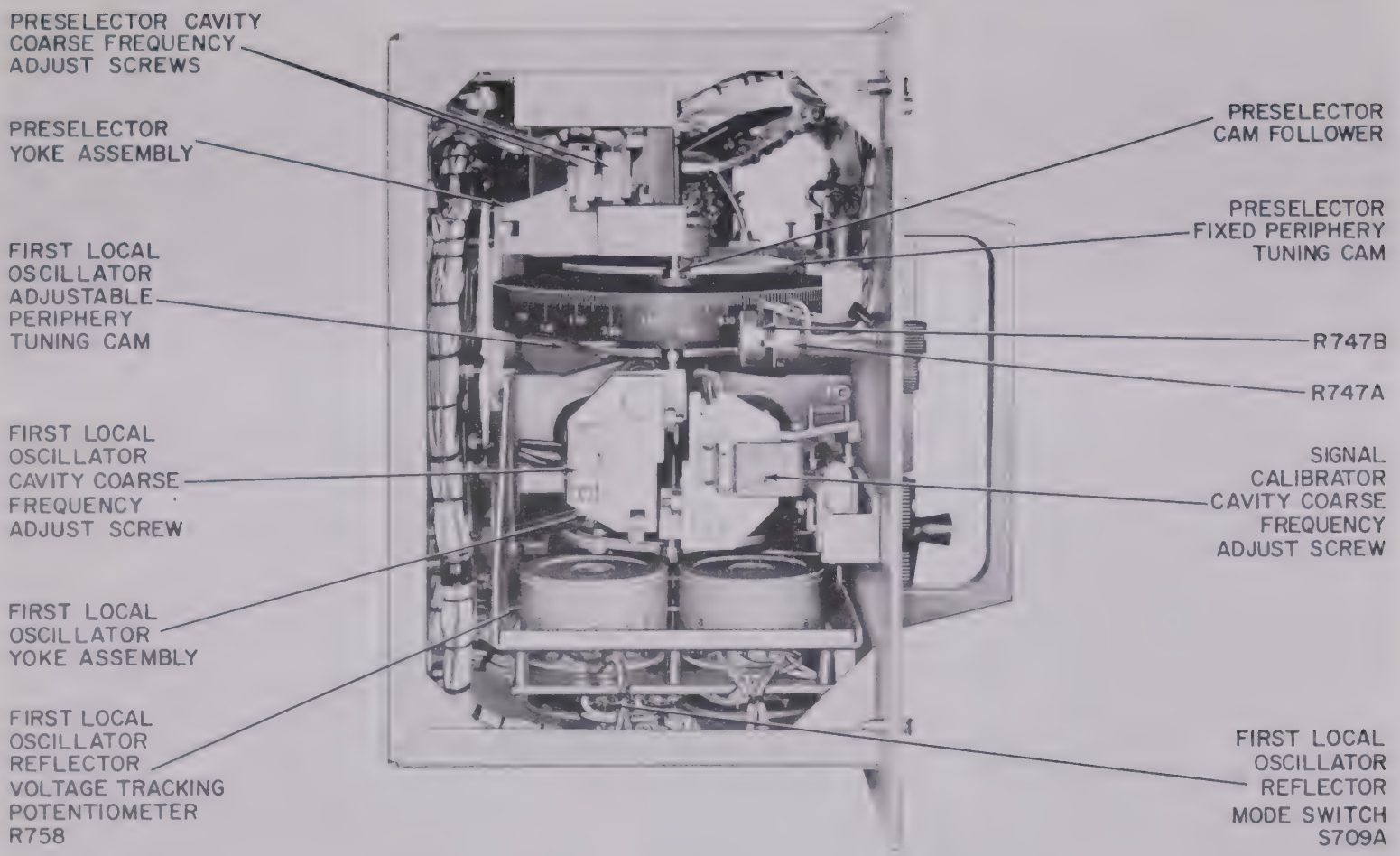

PRESELECTOR CAVITY COARSE FREQUENCY ADJUST SCREWS
PRESELECTOR YOKE ASSEMBLY
FIRST LOCAL OSCILLATOR ADJUSTABLE PERIPHERY TUNING CAM
FIRST LOCAL OSCILLATOR CAVITY COARSE FREQUENCY ADJUST SCREW
FIRST LOCAL OSCILLATOR YOKE ASSEMBLY
FIRST LOCAL OSCILLATOR REFLECTOR VOLTAGE TRACKING POTENTIOMETER R758
PRESELECTOR CAM FOLLOWER
PRESELECTOR FIXED PERIPHERY TUNING CAM
R747B
R747A
SIGNAL CALIBRATOR CAVITY COARSE FREQUENCY ADJUST SCREW
FIRST LOCAL OSCILLATOR REFLECTOR
MODE SWITCH S709A

Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 3 of 5)

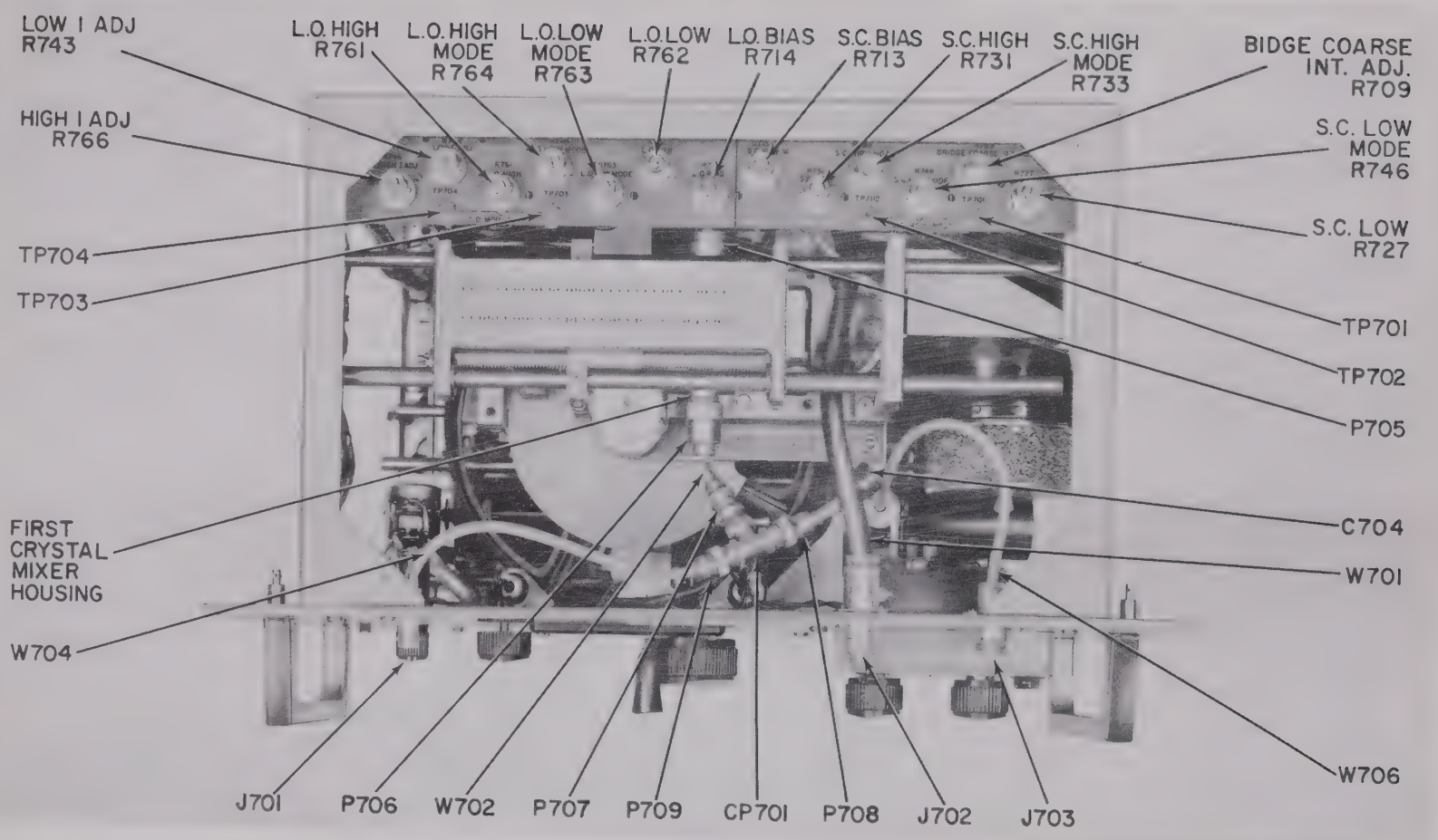


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 4 of 5)

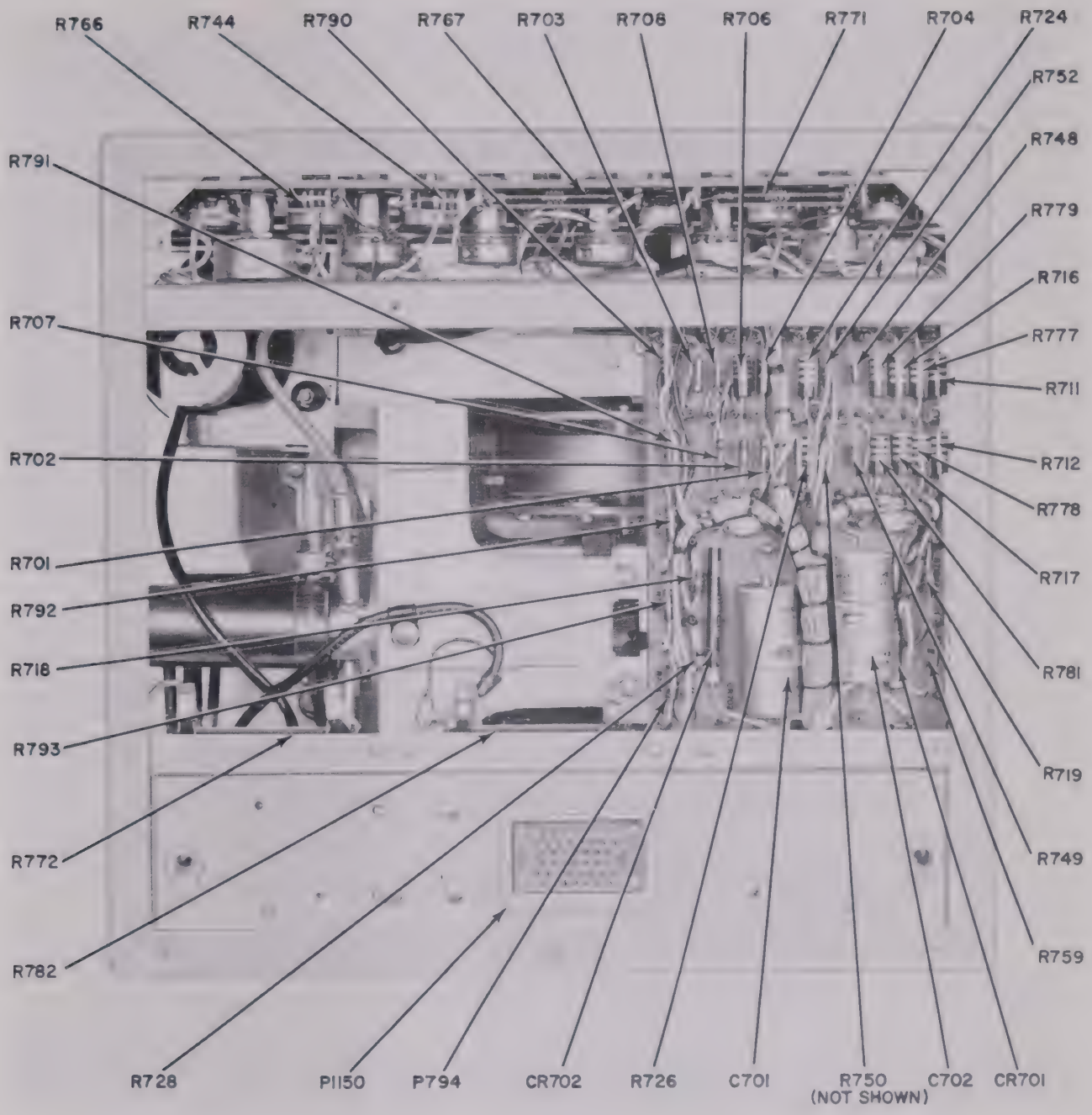


Figure 4-25. Model FIM-X2 Tuning Unit, Subassembly and Component Location Diagram (Sheet 5 of 5)

4-64. FIRST CRYSTAL MIXER, REPLACEMENT.

4-65. To replace the first crystal mixer, proceed as outlined in the following steps.

a. Disconnect P406, P506, P606, or P706, depending upon the Tuning Unit being repaired, from the first crystal mixer housing connector.

b. Remove the defective crystal.

c. Replace the defective crystal with an appropriate operative crystal, as listed below in table 4-14.

TABLE 4-14. FIRST CRYSTAL MIXER TYPES.

Tuning Unit	First Crystal Mixer Reference Symbol Number	First Crystal Mixer Type
Model FIM-L2	CR403	1N23C
Model FIM-S2	CR503	1N23C
Model FIM-M2	CR603	1N23C
Model FIM-X2	CR603	1N2510

d. Reconnect P406, P506, P606, or P706, as applicable, to the first crystal mixer housing connector.

4-66. FIRST LOCAL OSCILLATOR, TUBE REPLACEMENT.

4-67. The reflex klystrons employed as the first local oscillators (V402, V502, V602, and V702) are seated within the right end of the first local oscillator external resonant cavity, when viewed from the front of the Tuning Unit. The protruding base of the tube is covered by a protective shield, on which the tube type, tube reference symbol number, and tube socket reference symbol number are screened.

4-68. MODEL FIM-L2 AND FIM-S2 TUNING UNITS. In replacement of the first local oscillator reflex klystron of these Tuning Units is necessary, proceed as outlined in the following steps.

WARNING:

HIGH VOLTAGES EXIST AT THE BASE CONNECTORS OF THE REFLEX KLYSTRON. BE SURE THAT THE FIM-2 IS UNENERGIZED BEFORE ATTEMPTING TO REPLACE THE FIRST LOCAL OSCILLATOR TUBE.

a. Disconnect electrical power cable assembly W1201.from Basic Unit Power Input receptacle J100.

b. With the Tuning Unit withdrawn from the Basic Unit, locate the first local oscillator protective shield.

c. Loosen the single clamp screw that secures the protective shield to the knurled first local oscillator external resonant cavity end collar.

d. Carefully remove the protective shield. The knurled end collar, tube socket, and base of the reflex klystron will now be visible and accessible.

e. Carefully remove the socket from the base connectors of the reflex klystron.

f. Place klystron wrench H1204 over the protruding portion of the reflex klystron. Move the wrench forward until contact is made with the knurled end collar. Rotate the klystron wrench to engage its pins with the holes in the end collar.

g. Gently, but with pressure if necessary, rotate the klystron wrench counterclockwise to loosen the end collar.

h. Remove the klystron wrench.

i. Rotate the end collar by hand and remove it from the end of the external resonant cavity. The base of the reflex klystron can

now be easily gripped.

j. Grasp the protruding portion of the tube and, with a clockwise twisting motion, slowly withdraw it from the cavity.

NOTE:

Should the toroidal spring and spacing washer, which are contained within the cavity, come out as the tube is withdrawn, be sure to reinsert them before inserting the replacement reflex klystron. The toroidal spring is to be inserted first, followed by the spacing washer.

k. Insert the replacement reflex klystron into the cavity, applying a clockwise twisting motion to the base of the tube as it enters the cavity. A slight but noticeable resistance will be felt as the reflex klystron contact ring engages the toroidal spring. Continue twisting the tube, while simultaneously pressing it further into the cavity, until a positive stop is obtained. At this point the tube is properly seated within the cavity.

l. Replace the knurled end collar on the end of the cavity and hand-tighten the collar.

m. Place klystron wrench H1204 over the protruding portion of the tube. Move the wrench toward the knurled end collar until contact is made between the two. Rotate the wrench to engage its pins with the holes in the end collar.

n. Firmly tighten the end collar by rotating the klystron wrench counterclockwise.

o. Remove the klystron wrench.

CAUTION:

NEVER USE FORCE WHEN MATING THE SOCKET TO THE BASE CONNECTORS OF THE REPLACEMENT REFLEX KLYSTRON. SINCE IT IS POSSIBLE TO MATE THE SOCKET IN A MIS-ALIGNED POSITION, FORCED MATING OF THE SOCKET WILL RESULT IN PERMANENT DAMAGE TO THE REFLEX KLYSTRON UPON APPLICATION OF OPERATING POWER. OBSERVE THE MARKINGS ON BOTH THE BASE OF THE TUBE AND THE SOCKET. OBSERVE THESE MARKINGS WHEN MATING THE SOCKET TO THE TUBE.

p. Mate the socket to the base connectors of the replacement reflex klystron.

q. Replace the protective shield over the protruding portion of the replacement tube so that the open end of the shield covers the knurled end collar.

r. Tighten the single clamp screw that secures the protective shield to the end collar.

s. Rotate L.O. Opr Bias control R414 or R514, depending on the Tuning Unit being repaired, fully counterclockwise.

t. Proceed to paragraph 4-70.

4-64. MODEL FIM-M2 AND FIM-X2 TUNING UNITS. If replacement of the first local oscillator reflex klystron of these Tuning Units is necessary, proceed as outlined in the following steps.

WARNING:

HIGH VOLTAGES EXIST AT THE BASE CONNECTORS OF THE REFLEX KLYSTRON. BE SURE THAT THE FIM-2 IS UNENERGIZED BEFORE ATTEMPTING TO REPLACE THE FIRST LOCAL OSCILLATOR TUBE.

a. Disconnect electrical power cable assembly W1201 from Basic Unit Power Input receptacle J100.

b. Locate the first local oscillator protective shield.

c. Loosen the single clamp screw that secures the protective shield to the knurled first local oscillator external resonant cavity

end collar.

d. Carefully remove the protective shield. The first local oscillator reflex klystron tube base, socket, and knurled end collar will now be visible and accessible.

e. Carefully remove the socket from the base of the reflex klystron.

f. Place klystron wrench H1205 over the protruding portion of the reflex klystron. Move the wrench forward until it makes contact with the knurled end collar. Rotate the wrench to engage its pins with the holes in the end collar.

NOTE:

Do not remove the end collar from the cavity.

g. Gently, but using pressure if necessary, rotate the klystron wrench counterclockwise to loosen the end collar. Since the base of the reflex klystron protrudes well beyond the knurled end collar, removal of the latter from the cavity is not required.

h. Remove the klystron wrench.

i. Grasp the protruding portion of the reflex klystron and, with a clockwise twisting motion, slowly withdraw it from the cavity.

j. Insert a replacment reflex klystron into the cavity, using a clockwise twisting motion as the tube enters the cavity. Two slight but distinct resistances will be encountered as the reflex klystron contact ring engages the toroidal springs contained within the cavity. Continue twisting the tube, while simultaneously pressing

it further into the cavity, until the tube meets a positive stop. At this point the tube is properly seated within the cavity.

k. Replace the klystron wrench over the protruding portion of the tube. Move the wrench toward the end collar until contact is made between the two. Rotate the klystron wrench to engage its pins with the holes in the end collar.

l. Firmly tighten the knurled end collar by rotating the klystron wrench clockwise.

m. Remove the klystron wrench.

CAUTION:

NEVER USE FORCE WHEN MATING THE SOCKET TO THE BASE CONNECTORS OF THE REPLACEMENT REFLEX KLYSTRON. SINCE IT IS POSSIBLE TO MATE THE SOCKET IN A MIS-ALIGNED POSITION, FORCED MATING OF THE SOCKET WILL RESULT IN PERMANENT DAMAGE TO THE REFLEX KLYSTRON UPON APPLICATION OF OPERATING POWER. OBSERVE THE MARKINGS ON BOTH THE BASE OF THE TUBE AND THE SOCKET. OBSERVE THESE MARKINGS WHEN MATING THE SOCKET TO THE TUBE.

n. Mate the tube socket to the base connectors of the replacement reflex klystron.

o. Replace the protective shield over the protruding portion of the tube so that the open end of the shield covers the knurled end collar.

p. Tighten the single clamp screw that secures the protective shield to the knurled end collar.

q. Rotate L.O. Opr Bias control R614 or R714, depending on the Tuning Unit being repaired, fully counterclockwise.

r. Proceed to paragraph 4-70.

4-70. FIRST LOCAL OSCILLATOR, REFLECTOR VOLTAGE TRACKING.

4-71. Due to variations in reflex klystron tube characteristics, the replacement of the first local oscillator will necessitate retracking of the reflex klystron reflector voltage. The procedure for tracking the reflector voltage for the Model FIM-L2 and FIM-X2 Tuning Units, which employ mode switching, is outlined in paragraph 4-72; that for the Model FIM-S2 and FIM-M2 Tuning Units, which do not employ mode switching, is outlined in paragraph 4-73.

4-72. MODEL FIM-L2 AND FIM-X2 TUNING UNITS. To retrack the first local oscillator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applied to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

b. Disconnect P706 (P406) from the first crystal mixer housing connector.

c. Remove first crystal mixer CR703 (CR403), inserting in its place a dummy crystal; one which has been purposely shorted by the removal of its detecting element and having its casing filled with solder.

d. Connect a length of RG-55/U coaxial cable between the first crystal mixer housing connector and the input connector of a frequency meter, as shown in figure 4-26.

e. Connect a crystal detector, having a d-c return, between the output connector of the frequency meter and the vertical input terminals of a high-gain oscilloscope, as shown in figure 4-26.

NOTES:

1. FXR Model N410A Frequency Meter used with Model FIM-L2 Tuning Unit.
   FXR Model N410A and H410A Frequency Meters used with Model FIM-S2 Tuning Unit.
   FXR Model H410A and C410A Frequency Meters used with Model FIM-M2 Tuning Unit.
   FXR Model W410A Frequency Meter used with Model FIM-X2 Tuning Unit.

2. PRD Model 357 Waveguide-to-Coax Adapter used with FXR Model H410A Frequency Meter.
   PRD Model 356A Waveguide-to-Coax Adapter used with FXR Model C410A Frequency Meter.
   PRD Model 354B Waveguide-to-Coax Adapter used with FXR Model W410A Frequency Meter.

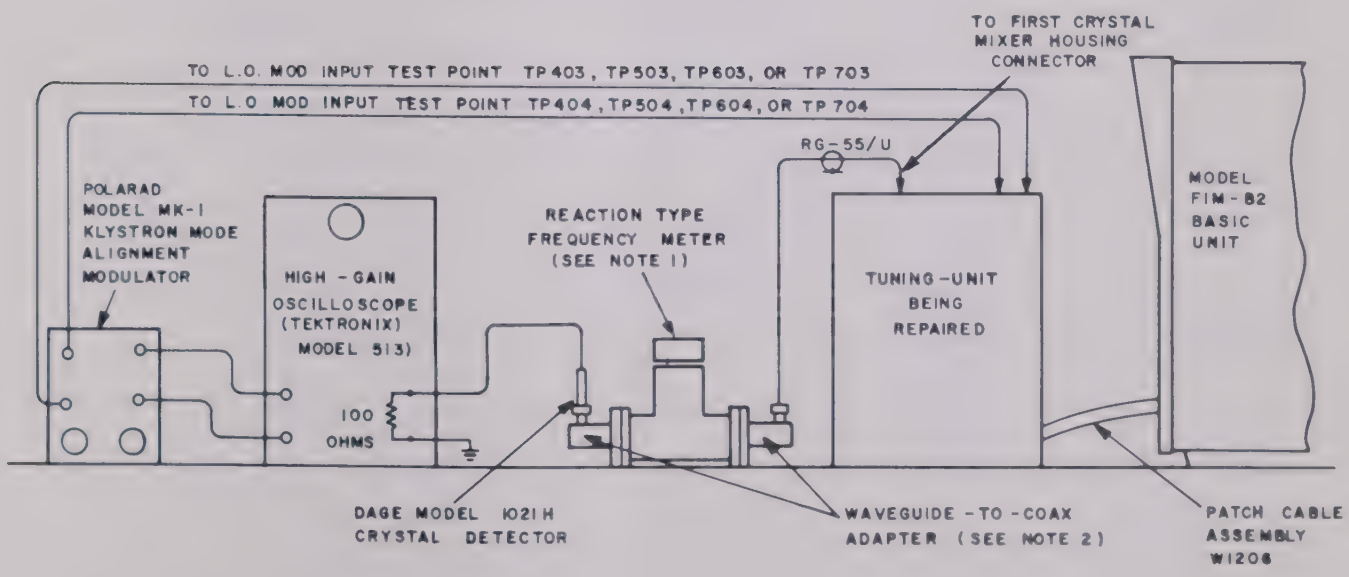

TO FIRST CRYSTAL MIXER HOUSING CONNECTOR
TO L.O. MOD INPUT TEST POINT TP403, TP503, TP603, OR TP703
TO L.O MOD INPUT TEST POINT TP404, TP504, TP604, OR TP704
RG-55/U
POLARAD MODEL MK-I KLYSTRON MODE ALIGNMENT MODULATOR
HIGH-GAIN OSCILLOSCOPE (TEKTRONIX) MODEL 513)
REACTION TYPE FREQUENCY METER (SEE NOTE 1)
TUNING-UNIT BEING REPAIRED
MODEL FIM-82 BASIC UNIT
100 OHMS
DAGE MODEL 1021H CRYSTAL DETECTOR
WAVEGUIDE-TO-COAX ADAPTER (SEE NOTE 2)
PATCH CABLE ASSEMBLY W1208

Figure 4-26. Tracking First Local Oscillator Reflector Voltage, Equipment Set Up.

oscilloscope, as shown in figure 4-26.

f. Connect the "reflector" terminals of the Polarad Model MK-1 Klystron Mode Alignment Modulator to the Tuning Unit L.O. Mod Input test points, TP703 and TP704 (TP403 and TP404), as shown in figure 4-26. If the Model MK-1 is not available, an equivalent klystron modulator can be constructed with the aid of the schematic diagram supplied in figure 4-27.

g. Connect the horizontal input terminals of the high-gain oscilloscope to the Model MK-1 "h scope" and "ground" terminals, as shown in figure 4-26.

h. Set the POWER switch to OFF.

i. Connect patch cable assembly W1206 between P1150 of the Tuning Unit being repaired and J1150 of the Basic Unit, as shown in figure 4-26.

j. Apply operating power to the FIM-2.

k. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least fifteen minutes.

l. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region will necessitate retracking of the signal calibrator reflector voltage. Refer to paragraph 4-90.

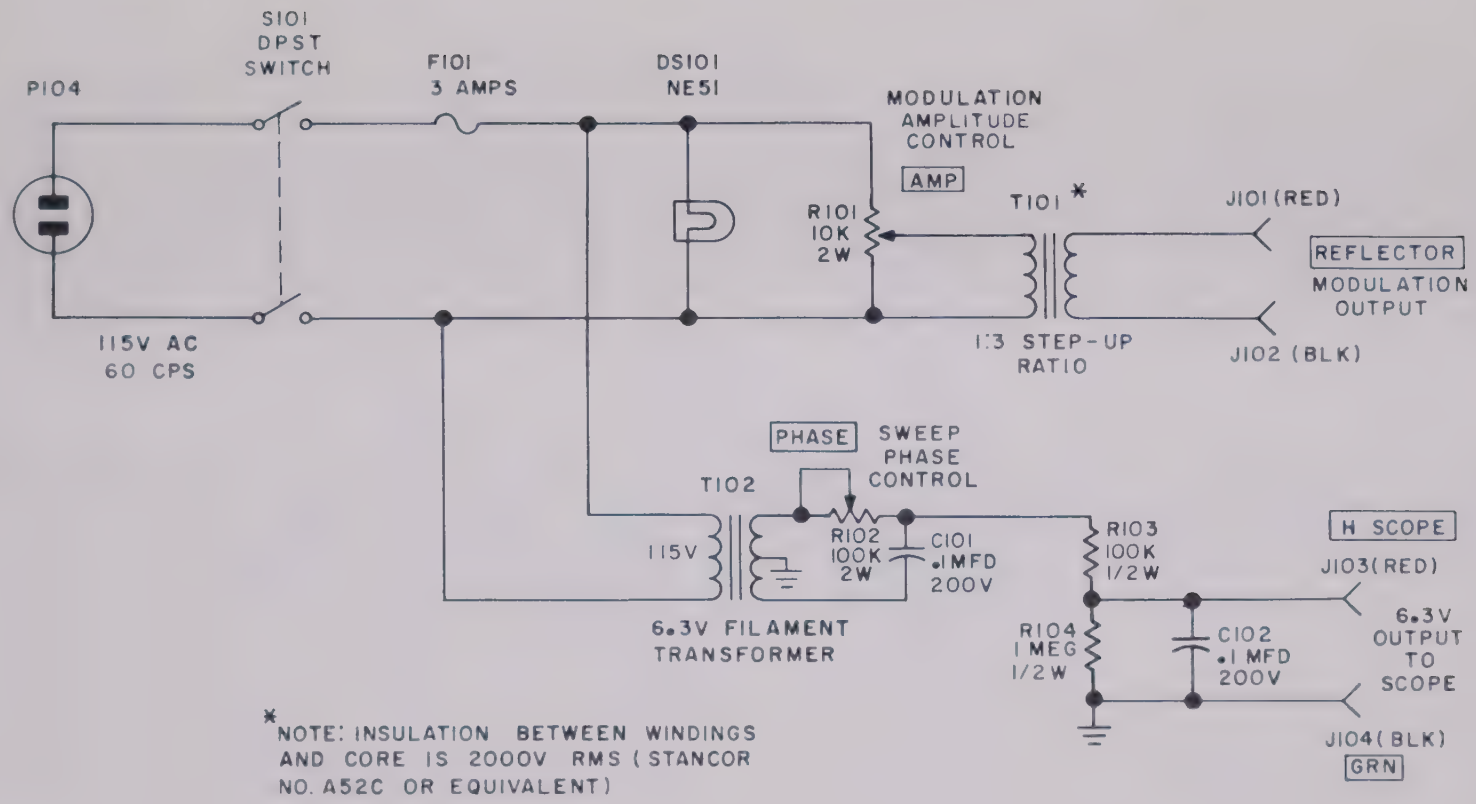


Figure 4-27. Klystron Mode Alignment Modulator, Schematic Diagram

m. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

n. Set the FUNCTION SEL switch to OPERATE.

o. Set Test Selector switch S351 to Anode Ma.

p. Adjust L.O. Opr Bias control R714 (R414) to obtain a power monitor meter pointer deflection corresponding to figure 4-28 (figure 4-29).

NOTE:

In the Model FIM-X2 Tuning Unit, the first local oscillator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES drum. In the Model FIM-L2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers

q. Rotate the TUNING control so that the first local oscillator cam follower is at the fixed point of the first local oscillator adjustable periphery tuning cam. (See figure 4-30.)

r. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope. If the mode pattern is not centered, as shown in figure 4-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to a point just above the mode switching point.

2. Center the mode pattern on the oscilloscope screen by adjusting L.O. High Mode control R764 (R464). (See figure 4-31b.)

3. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

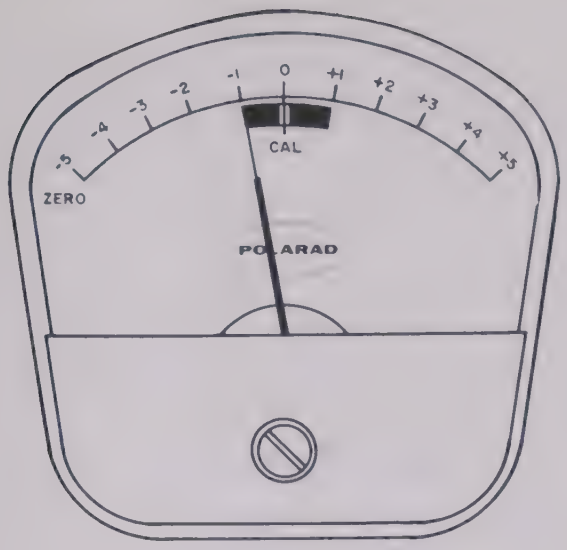


Figure 4-28. Power Monitor Meter Pointer Deflection Corresponding to "Anode Ma" Set, Models FIM-X2 and FIM-M2 Tuning Units (FUNCTION SEL Switch Set to OPERATE)

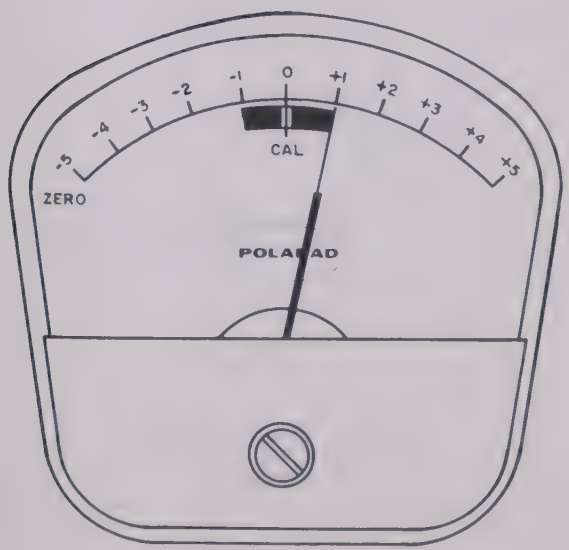


Figure 4-29. Power Monitor Meter Pointer Deflection Corresponding to "Anode Ma" Set, Models FIM-L2 and FIM-S2 Tuning Units (FUNCTION SEL Switch Set to OPERATE)

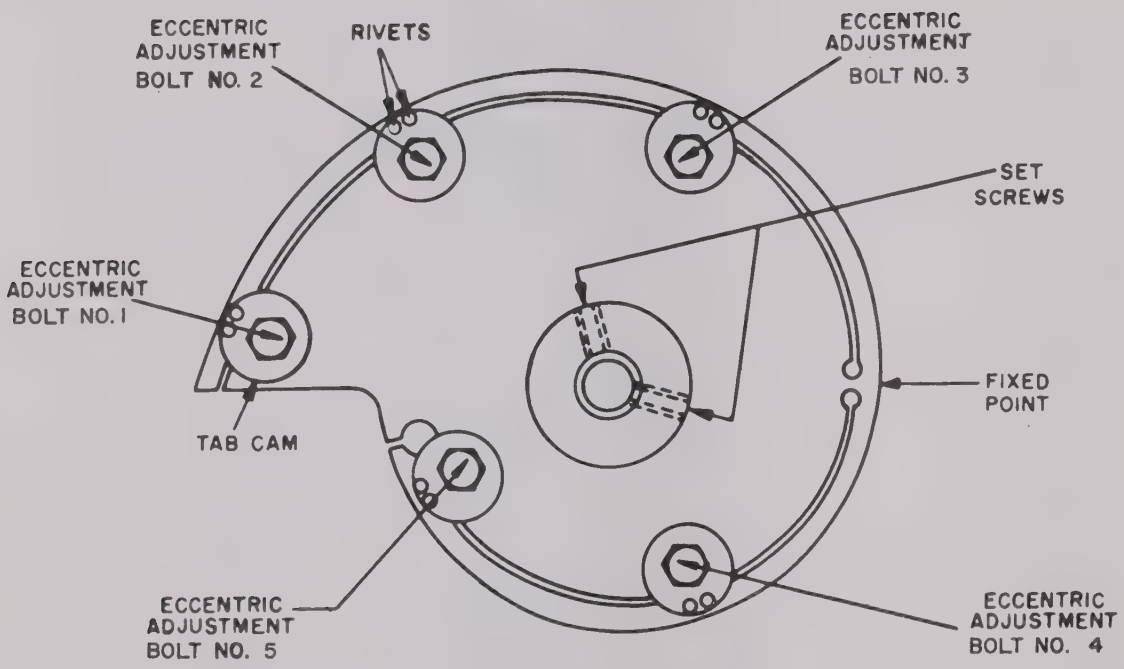


Figure 4-30. Typical Adjustable Periphery Tuning Cam

A. MODE PATTERN NOT CENTERED

B. MODE PATTERN CENTERED

C. MODE PATTERN REDUCED TO SINGLE TRACE

D. DIP AT PEAK OF MODE PATTERN

Figure 4-31. Typical Mode Pattern Displays

4. Connect the positive probe of a d-c vtvm to pin 3 of TB701 (TB401). Connect the common probe to L.O. Mod Input test point TP703 (TP403).

5. Note the vtvm reading. A reading within the limits of 115 and 200 volts (75 and 125 volts) indicates that the reflex klystron is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

6. Rotate the TUNING control to a point just below the mode switching point.

7. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low Mode control R763 (R463).

8. Note the vtvm reading. A reading within the limits of 275 and 360 volts (215 and 265 volts) indicates that the reflex klystron is operating within the desired 3-3/4-wave (1-3/4-wave) reflector mode.

9. Rotate the TUNING control to the high end of the band.

10. Center the mode pattern on the oscilloscope screen by adjusting L.O. High control R761 (R461).

11. Note the vtvm reading. A reading within the limits of 165 and 265 volts (255 and 305 volts) indicates that the reflex klystron is operating within the desired 4-3/4-wave (2-3/4-wave) reflector mode.

12. Rotate the TUNING control to the low end of the band.

13. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low control R762 (R462).

14. Note the vtvm reading. A reading within the limits of 125 and 200 volts (140 and 190 volts) indicates that the reflex klystron is operating in the desired 3-3/4-wave (2-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the frequency range of the Tuning Unit being repaired.

s. Remove the voltmeter.

t. Rotate the TUNING control from one end of the band to the other. Note the mode pattern displayed on the oscilloscope screen. The pattern should be continuous and display no splitting or loss of power at any point, and should remain centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinutiy. Remove operating power from the FIM-2 and loosen the single clamp screw that secures the protective shield to the knurled end collar. Remove the protective shield and adjust spanner wrench H1206 so that it engages the holes in the knurled end collar. Loosen the end collar and gently twist the reflex klystron tube clockwise. Tighten the end collar and replace the protective shield. Reenergize the FIM-2 and rescan the band for continuity as outlined in step t, above.

Since the orientation of the reflex klystron tube within the first local oscillator external resonant cavity for optimum performance cannot be anticipated, it is suggested that the reflex klystron twisting operation be performed in 30-degree increments until continuity throughout the band is achieved.

u. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note

the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the frequency meter to a frequency 260 mc below (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the first local oscillator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-31d.

x. Rotate the TUNING control so that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

y. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY IN KILOMEGACYCLES dial and frequency meter indications. The latter should be 260 mc ± 1% below (260 mc ± 1% above) the former.

z. Repeat steps x and y, above, for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter resonant frequency should be 260 mc ± 1% below (260 mc ± 1% above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial. If the frequency difference is greater than that specified, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL THE ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING OF THE RIVETS THAT SECURE THE TABS TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

NOTE:

If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3. If the error occurs at the low end of the band, loosen, in order, eccentric adjustment bolts no. 4 and 5.

1. Rotate the TUNING control to position the cam follower opposite the fixed point of the adjustable periphery tuning cam.

2. Rotate the TUNING control toward the high end of the band or the low end, as necessary, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to a frequency 260 mc below (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.

4. Adjust the position of the adjustable periphery tuning cam tab so that the dip appears at the peak of the displayed mode pattern.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 3, 4, and 5, above, for the remaining eccentric adjustment bolts.

aa. Remove the leads from the L.O. Mod Input test points.

ab. Disconnect the length of RG-55/U coaxial cable from the first crystal mixer housing connector.

ac. Replace the dummy first crystal mixer with the operative first crystal mixer.

ad. Connect P706 (P406) to the first crystal mixer housing connecotr.

ae. Set Test Selector switch S351 to Xtal Cur.

af. Rotate the TUNING control throughout the band, noting the power monitor meter pointer. The power monitor meter pointer

should deflect smoothly over the scale as the TUNING control is rotated throughout the band.

NOTE:

Retracking of the first local oscillator reflector voltage will necessitate retracking of the preselector. Refer to paragraph 4-92.

4-73. MODELS FIM-S2 AND FIM-M2 TUNING UNITS. To retrack the first local oscillator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

Tne information contained within the parenthesis applies to the Model FIM-S2 Tuning Unit, and immediately follows the information applying to the Model FIM-M2 Tunint Unit.

a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

b. Disconnect P606 (P506) from the first crystal mixer housing connector.

c. Remove first crystal mixer CR603 (CR503), inserting in its place a dummy crystal; one which has been purposely shorted by the removal of its detecting element and having its casing filled with solder.

d. Connect a length of RG-55/U coaxial cable between the first crystal mixer housing connector and the input connector of a frequency meter, as shown in figure 4-26.

e. Connect a crystal detector, having a d-c return, between the output connector of the frequency meter and the vertical input terminals of a high-gain oscilloscope, as shown in figure 4-26.

f. Connect the "reflector" terminals of the Polarad Model MK-1 Klystron Mode Alignment Modulator (or equivalent, as shown in figure 4-27) to the Tuning Unit L.O. Mod Input test points, TP603 and TP604 (TP503 and TP504), as shown in figure 4-26.

g. Connect the horizontal input terminals of the high-gain oscilloscope to the Model MK-1 "h scope" terminals, as shown in figure 4-26.

h. Set the POWER switch to OFF.

i. Connect patch cable assembly W1206 between P1150 of the Tuning Unit being repaired and J1150 of the Basic Unit, as shown in figure 4-26.

j. Apply operating power to the FIM-2. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

k. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region will necessitate retracking of the signal calibrator reflector voltage. Refer to paragraph 4-91.

l. Adjust Refl Adjust Control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

m. Set the FUNCTION SEL switch to OPERATE.

n. Set Test Selector switch S351 to Anode Ma.

o. Adjust L.O. Opr Bias control R614 (R514) to obtain a power monitor meter pointer deflection corresponding to figure 4-28

(figure 4-29).

NOTE:

In the Model FIM-M2 Tuning Unit, the first local oscillator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-S2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

p. Rotate the TUNING control so that the first local oscillator cam follower is at the fixed point of the adjustable periphery tuning cam. (See figure 4-30.)

q. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen, as shown in figure 4-31a. If the mode pattern is not centered, as shown in figure 4-31b, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to the high end of the band.

2. Center the mode pattern on the oscilloscope screen by adjusting L.O. High control R661 (R561).

3. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

4. Connect the positive probe of a d-c vtvm to pin 3 of TB601 (TB501). Connect the common probe to L.O. Mod Input test point TP603 (TP503).

5. Note the vtvm reading. A reading within the limits of 500 and 600 volts (250 and 345 volts) indicates that the reflex klystron is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

6. Rotate the TUNING control to the low end of the band.

7. Center the mode pattern on the oscilloscope screen by adjusting L.O. Low control R662 (R502).

8. Note the vtvm reading. A reading within the limits of 100 and 200 volts (20 and 60 volts) indicates that the reflex klystron is operating in the desired 3-3/4-wave (3-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the frequency range of the Tuning Unit being repaired.

r. Remove the voltmeter.

s. Rotate the TUNING control from one end of the band to the other. Note the mode pattern displayed on the oscilloscope screen. The pattern should be continuous and display no splitting or loss of power at any point, and should remain centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinuity. Remove operating power from the FIM-2 and loosen the single clamp screw that secures the protective shield to the knurled end collar. Remove the protective shield and adjust spanner wrench H1206 so that it engages the holes in the knurled end collar. Loosen the end collar and gently twist the reflex klystron tube clockwise. Tighten the end collar and replace the protective shield. Re-energize the FIM-2 and rescan the band for discontinuities, as outlined in step s, above.

Since the orientation of the reflex klystron tube within the first local oscillator external resonant cavity for optimum performance cannot be anticipated, it is suggested that the reflex klystron twisting operation be performed in 30-degree increments until continuity throughout the band is achieved.

t. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

u. Tune the frequency meter to 260 mc above (260 mc above) that indicated on the FREQUENCY IN KILOMEGACYCLES dial.

v. Adjust the first local oscillator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-31d.

w. Rotate the TUNING control so that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

x. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note both the FREQUENCY IN KILOMEGACYCLES dial and frequency meter indications. The former should be 260 mc ± 1% above (260 mc ± 1% below) the latter.

y. Repeat steps w and x, above, for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter should be tuned to 260 mc above (260 mc above) the indication of the FREQUENCY IN KILOMEGACYCLES dial. If the frequency difference is outside the limits of 260 mc ± 1%, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL THE ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING OF THE RIVETS THAT SECURE THE TABS TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

1. If the error occurs at the high end of the band,

loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error is at the low end of the band, loosen, in the order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting opposite the fixed point of the adjustable periphery tuning cam, rotate the TUNING control toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to 260 mc above (260 mc above) this indication.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode pattern.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 5, above, for the remaining eccentric adjustment bolts.

z. Remove the leads from the L.O. Mod Input test points.

aa. Disconnect the length of RG-55/U coaxial cable from the first crystal mixer housing connector.

ab. Replace the dummy crystal with the operative first crystal mixer.

ac. Connect P606 (P506) to the first crystal mixer housing connector.

ad. Set Test Selector switch S351 to Xtal Cur. Rotate the TUNING control throughout the band. The power monitor meter pointer should deflect smoothly over the scale as the TUNING control is rotated.

NOTE:

After the first local oscillator reflector voltage has been retracked, it will be necessary to retrack the preselector. Refer to paragraph 4-92.

4-74. THERMISTOR BRIDGE CIRCUIT, TROUBLESHOOTING.

4-75. If the power monitor meter deflects to either beyond a deflection of +5 or below a deflection of ZERO when the FUNCTION SEL switch is set to CAL SIG GEN and the Test Sel switch set to Opr, the thermistor bridge circuitry is defective. To replace the signal calibrator thermistor probe, proceed as outlined in paragraph 4-76; to replace the signal calibrator thermistor mount, proceed as outlined in paragraph 4-80.

4-76. SIGNAL CALIBRATOR THERMISTOR PROBE, REMOVAL.

4-77. To remove the signal calibrator thermistor probe from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. With the POWER switch set to OFF and the Tuning Unit removed from the Basic Unit, unsolder the thermistor probe cable terminations on the external cavity support casting stand-off.

b. Loosen and remove the single cable clamp that secures the probe cable to the casting. Place the clamp and its associated hardware in an accessible location.

c. Loosen the two setscrews (1, figure 4-32) that secure the signal calibrator thermistor probe (2, figure 4-32) to the signal calibrator thermistor probe drive yoke (3, figure 4-32).

d. Carefully withdraw the signal calibrator thermistor probe and signal calibrator thermistor probe drive yoke from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32) and the signal calibrator thermistor probe drive rod (5, figure 4-32), respectively.

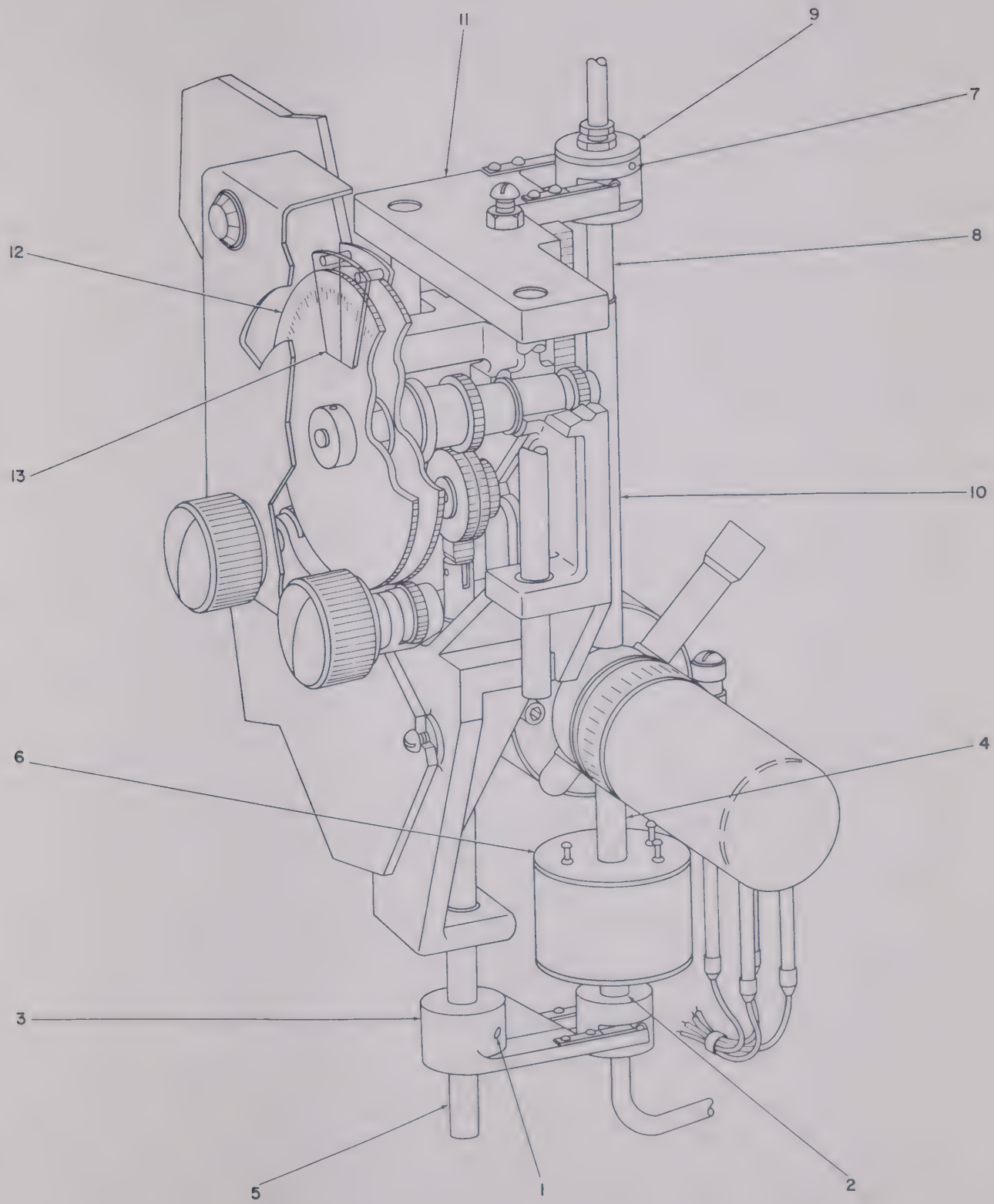


Figure 4-32. Signal Calibrator Power Set and Output Attenuator Drive Mechanism

e. Gently separate the signal calibrator thermistor probe and cable assembly from the signal calibrator thermistor probe drive yoke.

f. Place the signal calibrator thermistor probe drive yoke in an accessible location.

g. Proceed to paragraph 4-106.

4-78. SIGNAL CALIBRATOR THERMISTOR PROBE, REPLACEMENT.

4-79. To insert the replacement signal calibrator thermistor probe and yoke assembly into the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Carefully mate the replacement signal calibrator thermistor probe (2, figure 4-32) with the signal calibrator thermistor probe drive yoke (3, figure 4-32).

b. Carefully insert the tip of the signal calibrator thermistor probe into the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32).

c. Carefully slip the signal calibrator thermistor probe drive yoke (3, figure 4-32) over the signal calibrator thermistor probe drive rod (5, figure 4-32).

d. Adjust the position of the signal calibrator thermistor probe so that the line engraved on its barrel lines up with the line engraved on the signal calibrator external cavity power set waveguide-beyond- cutoff attenuator pipe.

e. Tighten the two setscrews on the signal calibrator thermistor probe drive yoke (1, figure 4-32), thereby securing the signal calibrator thermistor probe to the signal calibrator thermistor probe drive yoke.

f. Replace the thermistor probe cable clamp and resolder the thermistor probe cable to its termination on the external cavity support casting.

4-80. SIGNAL CALIBRATOR THERMISTOR MOUNT, REMOVAL.

4-81. To remove the signal calibrator thermistor mount from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Proceed as outlined in paragraph 4-76, steps a through c.

b. Loosen and remove the single screw that secures the thermistor mount cover plate to the signal calibrator thermistor mount (6, figure 4-32). Place the screw and its associated hardware in an accessible location.

c. Remove the thermistor mount cover plate.

d. Remove the tubular cover from the signal calibrator thermistor mount.

e. Loosen the two screws that secure the thermistor mount to the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32).

f. Remove the thermistor mount from the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe.

g. Unsolder the wires terminating on the signal calibrator thermistor mount.

4-82. SIGNAL CALIBRATOR THERMISTOR MOUNT, REPLACEMENT.

4-83. To replace the signal calibrator thermistor mount on the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Slip the thermistor mount onto the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, Figure 4-32).

b. Tighten the two thermistor mount screws, thereby securing the thermistor mount to the signal calibrator external cavity waveguide-beyond-cutoff attenuator pipe.

c. Replace the thermistor mount tubular cover.

d. Replace the thermistor mount cover plate.

e. Replace and tighten the single screw which secures the cover plate to the thermistor mount.

f. Resolder the leads to the thermistor mount.

g. Replace the thermistor probe, as outlined in paragraph 4-78, steps b through e.

h. Proceed to paragraph 4-106.

4-84. SIGNAL CALIBRATOR, TUBE REPLACEMENT.

4-85. The reflex klystrons employed as the signal calibrators V401, V501, V601, and V701) are partially seated within the right end of the signal calibrator external resonant cavity, as viewed from the front of the Tuning Unit. The signal calibrator reflex klystron, like the first local oscillator reflex klystron, has its protruding base covered by a protective shield, on which the tube reference symbol number, socket reference symbol number, and tube types are screened.

4-86 MODELS FIM-L2 AND FIM-S2 TUNING UNITS. If replacement of the signal calibrator reflex klystron of these Tuning Units is necessary, proceed as outlined in paragraph 4-68, substituting "signal calibrator" in place of "first local oscillator" and "S.C. Opr Bias control R413 or R513" in place of"L.O. Opr Bias control R414 or R514."

4-87. MODELS FIM-M2 AND FIM-X2 TUNING UNITS. If replacement of the signal calibrator reflex klystron of these Tuning Units is necessary, proceed as outlined in paragraph 4-69, substituting "signal calibrator" in place of "first local oscillator" and "S.C. Opr Bias control R613 or R713" in place of "L.O. Opr Bias control R614 or R714."

4-88. SIGNAL CALIBRATOR, REFLECTOR VOLTAGE TRACKING.

4-89. Due to variations in reflex klystron characteristics, the replacement of the signal calibrator will necessitate retracking of the reflex klystron signal calibrator reflector voltage. The procedure for tracking the reflector voltage of the Models FIM-L2 and FIM-X2 Tuning Unit signal calibrators, which employ mode switching, is outlined in paragraph 4-90; that for the Models FIM-S2 and FIM-M2 Tuning Unit signal calibrators, which do not employ mode switching, is outlined in paragraph 4-91.

4-90. MODELS FIM-L2 AND FIM-X2 TUNING UNITS. To retrack the signal calibrator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

a. Connect r-f cable assembly W1202 between the SIG GEN OUT jack and the input connector of a frequency meter, as shown in figure 4-33.

b. Connect a crystal detector, having a d-c return, to the output connector of the frequency meter, as shown in figure 4-33.

c. Connect the vertical input terminals of a high-gain oscilloscope across the output of the crystal detector, as shown in figure 4-33.

NOTES:

1. FXR Model N410A Frequency Meter used with Model FIM-L2 Tuning Unit.
   FXR Model N410A and H410A Frequency Meters used with Model FIM-S2 Tuning Unit.
   FXR Model H410A and C410A Frequency Meters used with Model FIM-M2 Tuning Unit.
   FXR Model W410A Frequency Meter used with Model FIM-X2 Tuning Unit.

2. PRD Model 357 Waveguide-to-Coax Adapter used with FXR Model H410A Frequency Meter.
   PRD Model 356A Waveguide-to-Coax Adapter used with FXR Model C410A Frequency Meter.
   PRD Model 354B Waveguide-to-Coax Adapter used with FXR Model W410A Frequency Meter.

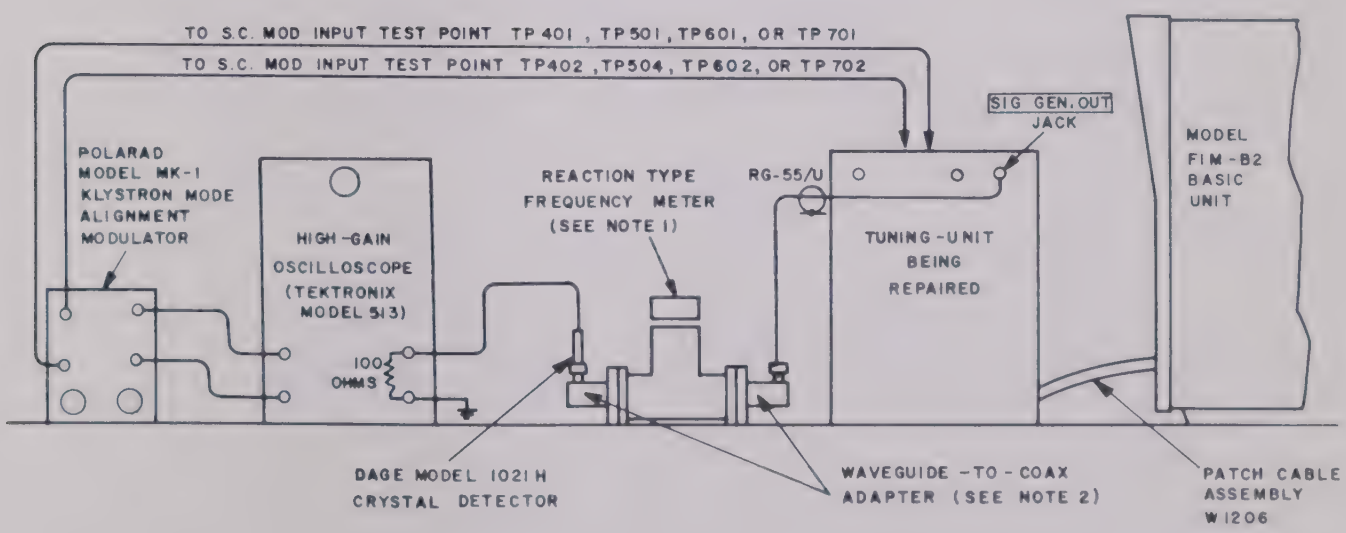

TO S.C. MOD INPUT TEST POINT TP401, TP501, TP601, OR TP701
TO S.C. MOD INPUT TEST POINT TP402, TP504, TP602, OR TP702
SIG GEN. OUT JACK
POLARAD MODEL MK-1 KLYSTRON MODE ALIGNMENT MODULATOR
HIGH-GAIN OSCILLOSCOPE (TEKTRONIX MODEL 513)
REACTION TYPE FREQUENCY METER (SEE NOTE 1)
RG-55/U
TUNING-UNIT BEING REPAIRED
MODEL FIM-B2 BASIC UNIT
100 OHMS
DAGE MODEL 1021H CRYSTAL DETECTOR
WAVEGUIDE-TO-COAX ADAPTER (SEE NOTE 2)
PATCH CABLE ASSEMBLY W1206

Figure 4-33. Tracking Signal Calibrator Reflector Voltage, Equipment Set Up.

d. Connect the "reflector" terminals of a Polarad Model MK-1 Klystron Mode Alignment Modulator (see figure 4-27) to the Tuning Unit S.C. Mod Input test points, TP701 and TP702 (TP401 and TP402), as shown in figure 4-33.

e. Connect the horizontal input terminals of the high-gain oscilloscope to the "h scope" and "ground" terminals of the MK-1, as shown in figure 4-33.

f. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-33.

g. Apply operating power to the FIM-2.

h. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

i. Set Test Selector switch S351 (located on the meter adjust board) to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region of the power monitor meter scale will necessitate retracking of the first local oscillator reflector voltage. Refer to paragraph 4-72.

j. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the power monitor meter scale.

k. Set the FUNCTION SEL switch to CAL SIG GEN.

l. Set the Test Selector switch to Anode Ma.

NOTE:

Be sure to first adjust the bias of the first local oscillator to obtain the proper "Anode Ma" set indication, as outlined in paragraph 4-73 (paragraph 4-72).

m. Adjust S.C. Opr Bias control R713 (R413) to obtain a power monitor meter pointer deflection shown in figure 4-35 (figure 4-35).

n. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam.

NOTE:

In the Model FIM-L2 Tuning Unit, the signal calibrator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-X2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

o. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.

p. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.

q. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen. If the mode pattern is not centered, as shown in figure 3-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following steps.

1. Rotate the TUNING control to a point just above the mode switching point.

2. Center the mode pattern on the oscilloscope screen, as shown in figure 4-31b, by adjusting S.C. High Mode control R733 (R433).

3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a convenient amplitude on the oscilloscope screen.

4. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

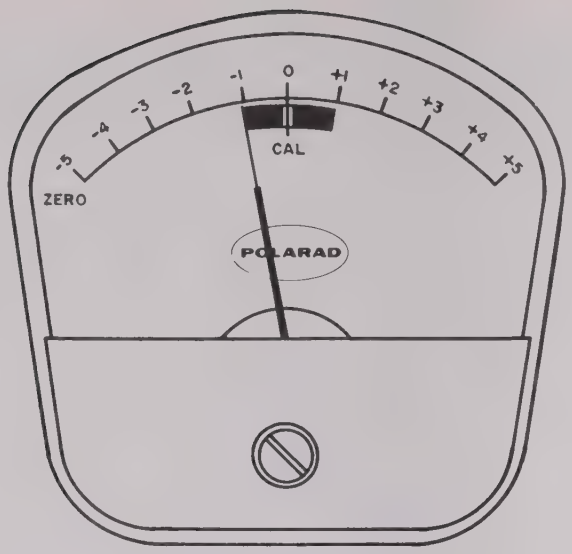


Figure 4-34. Power Monitor Meter Pointer Deflection Corresponding to "Anode Ma" Set, Models FIM-X2 and FIM-M2 Tuning Units (FUNCTION SEL Switch Set to CAL SIG GEN)

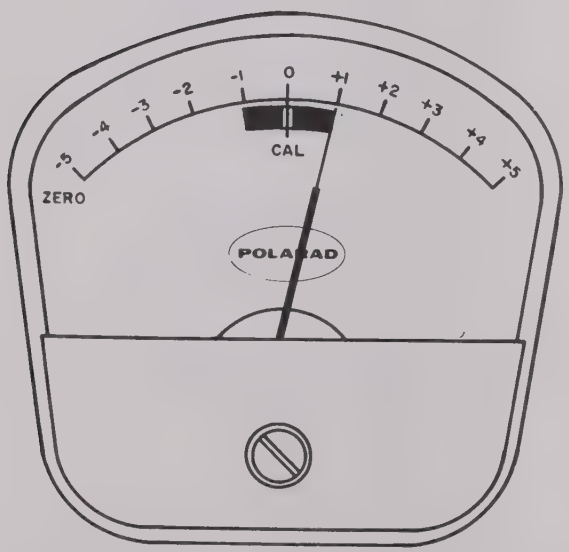


Figure 4-35. Power Monitor Meter Pointer Deflection Corresponding to "Anode Ma" Set, Models FIM-L2 and FIM-S2 Tuning Units (FUNCTION SEL Switch Set to CAL SIG GEN)

5. Connect the positive probe of a d-c vtvm to pin 3 of TB701 (TB401). Connect the common probe to S.C. Mod Input test point TP701 (TP401).

6. Note the vtvm reading. A reading within the limits of 125 and 210 volts (45 and 95 volts) indicates that the signal calibrator is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

7. Rotate the TUNING control to a point just below the mode switching point.

8. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low Mode control R746 (R446).

9. Note the vtvm reading. A reading within the limits of 290 and 375 volts (125 and 175 volts) indicates that the signal calibrator is operating in the desired 3-3/4-wave (1-3/4-wave) reflector mode.

10. Rotate the TUNING control to the high end of the band.

11. Center the mode pattern on the oscilloscope screen by adjusting S.C. High control R731 (R431).

12. Note the vtvm reading. A reading within the limits of 350 and 450 volts (210 and 260 volts) indicates that the signal calibrator is operating in the desired 4-3/4-wave (2-3/4-wave) reflector mode.

13. Rotate the TUNIN G control to the low end of the band.

14. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low control R775 (R475).

15. Note the vtvm reading. A reading within the limits of 150 and 225 volts (65 and 115 volts) indicates that the signal calibrator is operating in the desired 3-3/4-wave (1-3/4-wave) reflector mode.

r. Remove the vtvm.

s. Rotate the TUNING control from one end of the band to the other. The mode pattern displayed on the oscilloscope screen should be continuous and display no splitting or loss of power at any point, and remain centered on the oscilloscope screen.

NOTE:

If the mode pattern is erratic at any point within the band, rotate the TUNING control to the point of discontinuity and remove operating power from the FIM-2. Loosen the single clamp screw which secures the protective shield to the knurled end collar and remove the shield. Remove the klystron socket, loosen the end collar, and gently rotate the base of the reflex klystron clockwise. Tighten the end collar, replace the socket and shield, and reenergize the FIM-2. Rescan the band for continuity as in step s, above.

Since the orientation of the reflex klystron tube within the cavity for optimum performance cannot be anticipated, it is suggested that the tube rotating procedure be performed in 30-degree increments until continuity throughout the band is achieved.

t. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

u. Tune the frequency meter to that frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

v. Adjust the signal calibrator cavity coarse frequency adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode pattern, as shown in figure 4-31d.

w. Rotate the TUNING control to position the cam follower opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-30.)

x. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern, Note the FREQUENCY IN KILOMEGACYCLES dial indication and the frequency meter indication. They should be separated by no more than 1%.

y. Repeat steps w and x, above for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter indication should be separated by no more than 1% from the FREQUENCY IN KILOMEGACYCLES dial indication. If the frequency difference is outside the limit of 1%, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE FIRST BEEN LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB TO THE ADJUSTABLE PERIPHERY OF THE TUNING CAM.

1. If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error occurs at the low end of the band, loosen, in the order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting at the fixed point of the adjustable periphery tuning cam, rotate the TUNING control, either toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to this frequency.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 6, above, for the remainder of the eccentric adjustment bolts.

z. Remove the leads from the S.C. Mod Input test points.

aa. Disconnect r-f cable assembly W1202 from the SIG GEN OUT jack.

4-91. MODELS FIM-S2 AND FIM-M2 TUNING UNITS. To retrack the signal calibrator reflector voltage after the replacement of the reflex klystron, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-S2 Tuning Unit, and immediately follows the information applying to the Model FIM-M2 Tuning Unit.

a. Connect r-f cable assembly W1202 between the SIG GEN OUT jack and the input connector of a frequency meter, as shown in figure 4-33.

b. Connect a crystal detector, having a d-c return, to the output connector of the frequency meter, as shown in figure 4-33.

c. Connect the vertical input terminals of a high-gain oscilloscope across the output of the crystal detector, as shown in figure 4-33.

d. Connect the "reflector" terminals of the Model MK-1 Klystron Mode Alignment Modulator (see figure 4-27) to the Tuning

Unit S.C. Mod Input test points, TP601 and TP602 (TP501 and TP502), as shown in figure 4-33.

e. Connect the horizontal input terminals of the high-gain oscilloscope to the "h scope" and "ground" terminals of the Model MK-1, as shown in figure 4-33.

f. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-33.

g. Apply operating power to the FIM-2.

h. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light. Allow the FIM-2 to stabilize for 15 minutes.

i. Set Test Selector switch S351 to Refl.

NOTE:

Adjustment of Refl Adjust control R235 to obtain a power monitor meter pointer deflection within the green region of the scale will necessitate retracking of the first local oscillator reflector voltage. Refer to paragraph 4-73.

j. Adjust Refl Adjust control R235, if necessary, to obtain a power monitor meter pointer deflection within the green region of the scale.

k. Set the FUNCTION SEL switch to CAL SIG GEN.

l. Set Test Selector switch S351 to Anode Ma.

NOTE:

Be sure to first adjust the bias of the first local oscillator to obtain the proper "Anode Ma" set indication, as outlined in paragraph 4-73 (paragraph 4-72).

m. Rotate S.C. Opr Bias control R613 (R513) to obtain a power monitor meter pointer deflection corresponding to figure 4-34 figure 4-35).

n. Rotate the TUNING control to position the cam follower opposite the fixed point of the adjustable periphery tuning cam.

NOTE:

In the Model FIM-S2 Tuning Unit, the signal calibrator adjustable periphery tuning cam is located directly below the FREQUENCY IN KILOMEGACYCLES dial drum. In the Model FIM-M2 Tuning Unit, it is located directly above the reflector voltage tracking potentiometers.

o. Rotate the SIGNAL CALIBRATOR COARSE TUNING control to 0.

p. Rotate the SIGNAL CALIBRATOR FINE TUNING control to 0.

r. Adjust the Model MK-1 "amp" control to obtain a trace of the mode pattern on the oscilloscope screen. If the mode pattern is not centered, as shown in figure 4-31a, or does not appear on the oscilloscope screen, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to the high end of the band.

2. Center the mode pattern on the oscilloscope screen, as shown in figure 4-31b, by adjusting S.C. High control R631 (R531).

3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a display of convenient amplitude on the oscilloscope screen.

4. Adjust the Model MK-1 "phase" control to reduce the two traces that appear on the oscilloscope screen to a single trace, as shown in figure 4-31c.

5. Connect the positive probe of a d-c vtvm to pin 3 of TB601 (TB501). Connect the common probe to S.C. Mod Input test point TP601 (TP501).

6. Note the vtvm reading. A reading within the limits of 425 and 600 volts (230 and 330 volts) indicates that the signal calibrator is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

7. Rotate the TUNING control to the low end of the band.

8. Center the mode pattern on the oscilloscope screen by adjusting S.C. Low control R675 (R575).

9. Note the vtvm reading. A reading within the limits of 75 and 150 volts (20 and 60 volts) indicates that the signal calibrator is operating in the desired 2-3/4-wave (2-3/4-wave) reflector mode.

NOTE:

Due to some interaction between the above controls, it may be necessary to repeat the above steps for optimum setting of the controls throughout the Tuning Unit frequency range.

s. Remove the vtvm.

t. Rotate the TUNING control from one end of the band to the other. The mode pattern displayed on the oscilloscope screen should be continuous and exhibit no splitting or loss of power at any point, and remian centered on the oscilloscope screen.

NOTE:

If the displayed mode pattern is erratic at any point within the band, rotate the TUNING control to the discontinuity and remove operating power from the FIM-2. Loosen the single clamp screw that secures the protective shield to the end collar and remove the shield. Remove the klystron socket, loosen the end collar, and gently rotate the klystron tube clockwise. Replace the socket and shield and reenergize the FIM-2. Rescan the band for continuity as in step t, above.

Since the orientation of the reflex klystron tube within the external resonant cavity for optimum performance cannot be anticipated, it is suggested that the tube rotating procedure be performed in 30-degree increments until continuity throughout the band is achieved.

u. Rotate the TUNING control to position the cam follower at the fixed point of the adjustable periphery tuning cam. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the frequency meter to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the signal calibrator cavity coarse tuning adjust screw, shown in figure 4-25, sheet 3 of 5, to obtain a dip at the peak of the displayed mode, as shown in figure 4-31d.

x. Rotate the TUNING control to that the cam follower rests opposite eccentric adjustment bolt no. 1 of the adjustable periphery tuning cam. (See figure 4-27.)

y. Tune the frequency meter to obtain a dip at the peak of the displayed mode pattern. Note the FREQUENCY IN KILOMEGACYCLES dial indication and the frequency meter indication. They should be separated by no more than 1%.

z. Repeat steps x and y, above for the cam follower resting opposite eccentric adjustment bolts no. 2, 3, 4, and 5, in sequence. The frequency meter indication and FREQUENCY IN KILOMEGACYCLES dial indications should be separated by no more than 1%. If the frequency difference is greater than 1%, proceed as outlined in the following additional steps.

CAUTION:

NEVER ATTEMPT TO ADJUST ANY TAB ON THE ADJUSTABLE PERIPHERY TUNING CAM UNLESS ALL ECCENTRIC ADJUSTMENT BOLTS ON THAT SECTION OF THE CAM HAVE BEEN FIRST LOOSENED. FAILURE TO OBSERVE THIS PRECAUTION WILL RESULT IN STRIPPING THE RIVETS THAT SECURE THE TAB TO THE ADJUSTABLE PERIPHERY OF THE CAM.

1. If the error occurs at the high end of the band, loosen, in the order stated, eccentric adjustment bolts no. 1, 2, and 3; if the error occurs at the low end of the band, loosen, in the

order stated, eccentric adjustment bolts no. 4 and 5.

2. With the cam follower resting at the fixed point of the adjustable periphery tuning cam, rotate the TUNING control either toward the high end of the band or the low end of the band, as required, until the cam follower rests opposite eccentric adjustment bolt no. 3 or 4, respectively.

3. Note the FREQUENCY IN KILOMEGACYCLES dial indication. Tune the frequency meter to this frequency.

4. Adjust the position of the adjustable periphery tuning cam tab until the dip appears at the peak of the displayed mode.

5. Tighten the eccentric adjustment bolt.

6. Repeat steps 2 through 5, above for the remainder of the eccentric adjustment bolts.

aa. Remove the leads from the S.C. Mod Input test points.

ab. Disconnect r-f cable assembly W1202 from the SIG GEN OUT jack.

4-92. PRESELECTOR, ALIGNMENT.

4-93. Replacement of the first local oscillator reflex klystron will necessitate realignment of the Tuning Unit preselector. In the Models FIM-L2 and FIM-S2 Tuning Units, the preselectors are aligned by a series of adjusting screws located at the top of the preselector subassembly. In the Models FIM-M2 and FIM-X2 Tuning Units, they are aligned by an L-shaped rocker arm that is actuated by a cam follower driven by the profile of a tape cam. The profile of this tape cam is controlled by a series of adjusting screws located on a rack positioned above the preselector subassembly. If alignment of the Model FIM-L2 or FIM-S2 Tuning Unit preselector is required, proceed as outlined in paragraph 4-94. If alignment of the Model FIM-M2 or FIM-X2 Tuning Unit preselector is required, proceed as outlined in paragraph 4-95.

4-94. MODELS FIM-L2 AND FIM-S2 TUNING UNITS. To align the preselectors of these Tuning Units, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-L2 Tuning Unit, and immediately follows the information applying to the Model FIM-S2 Tuning Unit.

a. Set the POWER switch to OFF.

b. Loosen and remove the four screws that secure the preselector end plate to the preselector subassembly. Remove the end plate, placing the screws and their associated hardware in an accessible location.

c. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

d. Adjust the preselector fine tuning adjustment screws so that they are flush with the outer surface (inner surface) of the preselector subassembly (preselector cavity).

e. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-36.

f. Apply operating power to the FIM-2.

g. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.

h. Connect a length of RG-55/U coaxial cable between the MIXER OUT jack and the IF IN jack, as shown in figure 4-36.

i. Rotate the IF GAIN control to a front-panel indication of 6.

j. Remove all i-f attenuation from the system.

k. Set the FUNCTION SEL switch to OPERATE.

l. Set the OUTPUT switch to ZERO SET.

m. Adjust the output meter ZERO SET control to zero-set the output meter.

n. Rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication of 4.34 kmc (2.24 kmc).

o. Adjust a calibrated microwave signal generator, such as a Polarad Model MSG-2A Microwave Signal Generator (Polarad Model MSG-1 Microwave Signal Generator), for minimum output at the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

p. Connect the microwave signal generator to the PRESEL IN jack, as shown in figure 4-36.

NOTE:

Polarad Model MSG-1 Microwave Signal Generator used with Model FIM-L2 Tuning Unit.
Polarad Model MSG-2A Microwave Signal Generator used with Model FIM-S2 Tuning Unit.
Polarad Model PMX Microwave Signal Generator (with G-48 Tuning Unit) used with Model FIM-M2 Tuning Unit.
Polarad Model PMX Microwave Signal Generator (with G-711 Tuning Unit) used with Model FIM-X2 Tuning Unit.

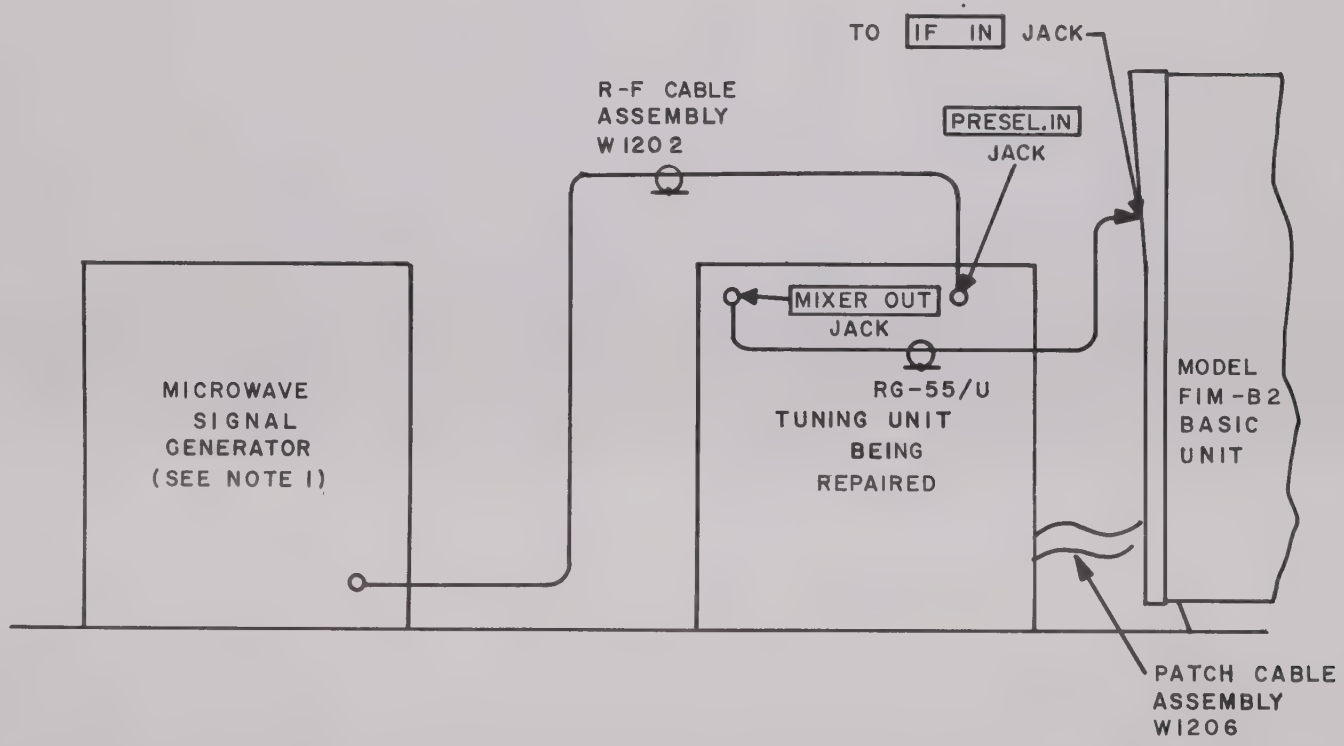


Figure 4-36. Preselector Alignment, Equipment Set Up

q. Set the OUTPUT switch to AVERAGE.

r. Adjust the output level of the microwave signal generator to 1,000 microvolts.

s. Note the output meter pointer deflection.

t. Adjust the preselector cavity coarse frequency adjust screws, shown in figure 4-25, sheet 3, to peak the deflection of the output meter pointer.

u. With the aid of a vernier caliper, determine the distance S from the end of the preselector subassembly to the center of the nearest preselector fine tuning adjustment screw, as shown in figure 4-37.

v. Insert the vernier caliper into the preselector cavity and adjust the TUNING control to position the preselector tuning plunger beneath the center of the nearest preselector fine tuning adjustment screw. This corresponds to the distance D in figure 4-37.

w. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

x. Tune the calibrated microwave signal generator to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

y. Adjust the output level of the calibrated signal generator to 1,000 microvolts.

z. Adjust the set of preselector fine tuning adjustment screws to peak the deflection of the output meter pointer.

aa. Repeat steps u through z, above, for the remaining sets of preselector fine tuning adjustment screws.

ab. After all the preselector fine tuning adjustment screws have been aligned, disconnect the calibrated microwave signal generator from the PRESEL IN jack and determine the sensitivity of the FIM-2 at various frequencies within the band. (Refer to paragraph 2-36.) The minimum sensitivity should be at least -81 dbm. If the

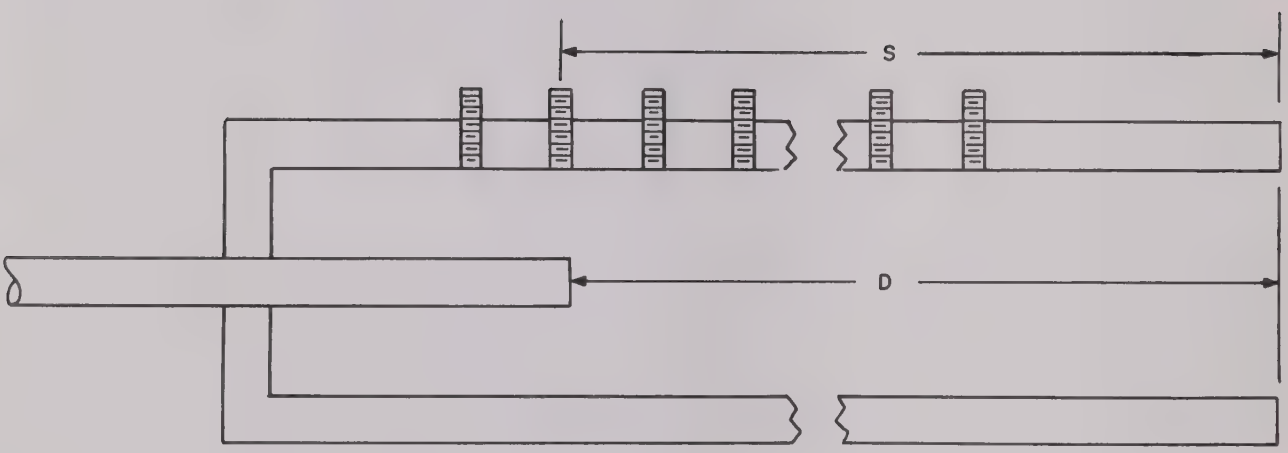


Figure 4-37. Models FIM-L2 and FIM-S2 Tuning Unit Preselector, Sectional Side View

sensitivity is low, readjustment of the preselector fine tuning adjustment screws will be necessary.

4-95. MODELS FIM-M2 AND FIM-X2 TUNING UNITS. To align the preselectors of these Tuning Units, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis applies to the Model FIM-M2 Tuning Unit, and immediately follows the information applying to the Model FIM-X2 Tuning Unit.

a. With the Tuning Unit removed from the Basic Unit, set the AFC switch to OUT.

b. Set the POWER switch to OFF.

c. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit, as shown in figure 4-36.

d. Apply operating power to the FIM-2.

e. Set the POWER switch to ON. Allow the FIM-2 to stabilize for at least 15 minutes.

f. Connect a length of RG-55/U coaxial cable between the MIXER OUT jack and the IF IN jack, as shown in figure 4-36.

g. Rotate the IF GAIN control to a front-panel indication of 6.

h. Remove all i-f attenuation from the system.

i. Set the FUNCTION SEL switch to OPERATE.

j. Set the OUTPUT switch to ZERO SET.

k. Adjust the output meter ZERO SET control to zero-set the output meter.

l. Rotate the TUNING control to obtain a FREQUENCY IN KILOMEGACYCLES dial indication of 10.00 kmc (7.74 kmc).

m. Adjust a calibrated microwave signal generator, such as the Polarad Model PMX Microwave Signal Generator, for minimum output at the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

n. Connect the microwave signal generator to the PRESEL IN jack, as shown in figure 4-36.

o. Set the OUTPUT switch to AVERAGE.

p. Adjust the output level of the calibrated microwave signal generator to 1,000 microvolts.

q. Note the output meter pointer deflection.

r. Adjust the preselector cavity coarse frequency adjust screws, shown in figure 4-25, sheet 3, to peak the deflection of the output meter pointer.

s. Place a small mirror, such as a dental mirror, beside the tape cam so that the cam may be easily viewed.

t. Adjust the TUNING control so that the L-shaped rocker arm rollers lie directly below the nearest set of preselector fine tuning adjustment screws.

u. Note the FREQUENCY IN KILOMEGACYCLES dial indication.

v. Tune the calibrated microwave signal generator to the frequency indicated on the FREQUENCY IN KILOMEGACYCLES dial.

w. Adjust the output level of the calibrated microwave signal generator to 1,000 microvolts.

x. Adjust the set of preselector fine tuning adjustment screws to peak the deflection of the output meter pointer.

y. Repeat steps t through x, above, for the remaining sets of preselector fine tuning adjustment screws.

z. After all the preselector fine tuning adjustment screws have been aligned, disconnect the calibrated microwave signal gener-

ator from the PRESEL IN jack and determine the sensitivity of the FIM-2 at various frequencies within the band. (Refer to paragraph 2-36.) The minimum sensitivity should be at least -81 dbm. If the sensitivity is low, readjustment of the preselector fine tuning adjustment screws will be necessary.

4-96. LOW-PASS FILTERS, TROUBLESHOOTING.

4-97. Low-pass filters are employed in the low-frequency Tuning Units; one each between the PRESEL IN jack and the input to the preselector subassembly in the Models FIM-L2 and FIM-S2 Tuning Units, the third between the output of the first crystal mixer and the MIXER OUT jack of the Model FIM-L2 Tuning Unit. To troubleshoot these low-pass filters, proceed as outlined in the following steps.

NOTE:

The information contained within the parenthesis refers to the filters between the MIXER OUT jack and the output of the first crystal mixer in the Model FIM-L2 Tuning Unit.

a. Connect a calibrated microwave signal generator, tuned to any frequency within the band, to the output connector of the filter. (Connect a calibrated signal generator, tuned to 260 mc, to the input connector of the filter.)

b. Adjust the output level of the calibrated microwave signal generator to 0 dbm. (Adjust the output level of the calibrated signal generator to 100,000 microvolts.)

c. Connect a microwave power meter, such as the Polarad Model P-3 Power Meter, to the PRESEL IN jack through a thermistor mount, such as the Polarad Model TM-1 Thermistor Mount. (Connect an a-c vtvm between the center and outer conductors of the MIXER OUT jack.)

d. Note the reading of the microwave power meter. It should indicate no less than -2 dbm. (Note the reading of the a-c vtvm. It should indicate no less than 0.795 volts.) In other words, the meximum insertion loss of the low-pass filter should be no greater than 2 db.

4-98. LOW-PASS FILTERS, REMOVAL.

4-99. To remove the low-pass filters from the Tuning Unit, proceed as outlined in the following steps.

a. Disconnect the r-f cable assembly, which couples the output of the low-pass filter to the input connector of the preselector, from the outpput connector of the filter. (Disconnect the i-f cable assembly, which couples the output of the low-pass filter to the MIXER OUT jack, from the output connector of the filter.)

NOTE:

When removing the low-pass filter between the MIXER OUT jack and the output of the first crystal mixer of the Model FIM-L2 Tuning Unit, remove the i-f cable assembly which couples the coaxial "tee" to the input connector of the low-pass filter.

b. Loosen and remove the four screws which secure the filter to the PRESEL IN mounting hole. (Loosen and remove the clamps which secure the filter to the Tuning Unit frame.)

c. Remove the filter.

4-100. LOW-PASS FILTER, REPLACEMENT.

4-101. To install the replacement low-pass filter, follow both the reverse procedure and sequence of paragraph 4-98, steps a through c.

4-102. SIGNAL CALIBRATOR OUTPUT ATTENUATOR PROBE, REMOVAL.

4-103. To remove the signal calibrator output attenuator probe from the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

b. Loosen and remove the four screws that secure the SIG GEN OUT jack to the Tuning Unit front panel. Place the screws and their associated hardware in an accessible location.

c. Remove the SIG GEN OUT jack from its mounting hole.

d. Loosen the two setscrews (7 , figure 4-32) that secure the signal calibrator output attenuator probe (8 , figure 4-32) to the signal calibrator output attenuator probe yoke (9 , figure 4-32).

e. Grasp the coaxial cable connecting the signal calibrator output attenuator probe and the SIG GEN OUT jack and carefully remove the signal calibrator output attenuator probe from both the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe (10, figure 4-32) and the signal calibrator output attenuator probe yoke (7, figure 4-32).

f. Grasp the signal calibrator output attenuator probe yoke and carefully remove it from its slotted mounting location in the signal calibrator output attenuator drive yoke (11, figure 4-32).

g. Place the signal calibrator output attenuator probe yoke in an accessible location.

4-104. SIGNAL CALIBRATOR OUTPUT ATTENUATOR PROBE, REPLACEMENT.

4-105. To insert the replacement signal calibrator output attenuator probe into the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe, proceed as outlined in the following steps.

a. Insert the signal calibrator output attenuator probe yoke (9 , figure 4-32) into its slotted mounting in the signal calibrator output attenuator drive yoke (11, figure 4-32). Be sure to orient the former so that its setscrews are located above the uppermost surface of the latter.

b. Insert the signal calibrator output attenuator probe (8 , figure 4-32) through the signal calibrator output attenuator probe yoke and into the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe (10, figure 4-32).

c. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully clockwise.

d. Adjust the position of the signal calibrator output attenuator probe so that:

1. the end of the signal calibrator output attenuator probe barrel is flush with the top surface of the signal calibrator output attenuator probe yoke, and

2. the line engraved on the signal calibrator output attenuator probe barrel lines up with the line engraved on the signal calibrator external cavity output attenuator waveguide-beyond-cutoff attenuator pipe.

e. Tighten the two setscrews (7 , figure 4-32), thereby securing the signal calibrator output attenuator probe to the signal calibrator output attenuator probe yoke.

f. Insert the SIG GEN OUT jack into its front panel mounting hole and replace the four mounting screws.

g. Tighten the four screws, thereby securing the SIG GEN OUT jack to the Tuning Unit front panel.

h. Proceed to paragraph 4-106 to calibrate the output power of the signal calibrator.

4-106. SIGNAL CALIBRATOR POWER OUTPUT CALIBRATION.

4-107. To calibrate the output power of the signal calibrator after the replacement of the signal calibrator output attenuator probe, the signal calibrator thermistor probe, or the signal calibrator thermistor mount, proceed as outlined in the following steps.

a. Connect patch cable assembly W1206 between P1150 of the Tuning Unit and J1150 of the Basic Unit.

b. Apply operating power to the FIM-2.

c. Set the POWER switch to ON. Allow the 60-second delay period to transpire. At the end of the delay period the KLY pilot lamp will light, indicating that the high-voltage power supply is energized. Allow the FIM-2 to stabilize for at least 15 minutes.

d. Set the FUNCTION SEL switch to ZERO SET.

e. Rotate the power monitor meter ZERO SET control fully clockwise.

f. Adjust the Bridge Coarse Int Adj control (R409, R509, R609, or R709, depending on the Tuning Unit) to obtain a power monitor meter pointer deflection of +5 (full scale).

g. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

h. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise.

i. Set the FUNCTION SEL switch to CAL SIG GEN.

j. Connect a microwave power meter, such as the Polarad Model P-3 Microwave Power Meter, to the SIG GEN OUT jack through a thermistor mount, such as the Polarad Model TM-1 Thermistor Mount, as shown in figure 4-38.

k. Rotate the TUNING control to the low end of the band.

l. Rotate the SIGNAL CALIBRATOR POWER SET control fully clockwise.

m. Loosen the two setscrews (1, figure 4-32) that secure the signal calibrator thermistor probe (2, figure 4-32) to the signal calibrator thermistor probe drive yoke (3, figure 4-32).

CAUTION:

CARE SHOULD BE EXCERCISED SO AS NOT TO DAMAGE THE "HATS" THAT ARE LOCATED WITHIN THE SIGNAL CALIBRATOR EXTERNAL CAVITIES OF THE MODELS FIM-L2 AND FIM-M2 TUNING UNITS. SHOULD THESE "HATS" BE BENT OR DAMAGED IN ANY WAY, THE FREQUENCY ALIGNMENT OF THE SIGNAL CALIBRATOR WILL BE VOID.

n. Carefully adjust the degree of insertion of the signal calibrator thermistor probe within the signal calibrator external cavity power set waveguide-beyond-cutoff attenuator pipe (4, figure 4-32) so that the power monitor meter pointer deflects to an indication of between +3 and +5.

o. Tighten the two setscrews (1, figure 4-32), thereby securing the signal calibrator thermistor probe to the signal calibrator thermistor probe drive yoke.

p. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

q. Rotate the TUNING control throughout the band. At various frequencies adjust the SIGNAL CALIBRATOR POWER SET control to ascertain that power monitor meter pointer deflections both above and below the CAL mark can be obtained.

r. Rotate the TUNING control to the low end of the band.

s. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

t. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial (12, figure 4-32) under the hairline of the power set indicator (13, figure 4-32).

u. Note the reading of the microwave power meter (in dbm).

v. Rotate the TUNING control throughout the band, stopping at increments of 100 mc. At each point readjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL, and then adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the hairline of the power set indicator. Note the microwave power meter reading at each point (in dbm). The difference between the maximum and minimum microwave power meter readings should be 4 db or less.

w. Substitute the values obtained for the maximum and minimum signal calibrator output power into the following formula to obtain the average overall db error

$$\text{Average overall db error} = \frac{P_{max}(\text{dbm}) - P_{min}(\text{dbm})}{2}$$

x. Rotate the TUNING control to the low-power frequency and adjust the LOCK lever to prevent the TUNING control from moving.

y. Loosen the two setscrews that secure the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control knob to its shaft.

z. Remove the knob from its shaft.

aa. Loosen the two setscrews that secure the SIGNAL CALIBRATOR POWER SET control knob to its shaft.

ab. Remove the knob from its shaft.

ac. Remove the two pilot lights from their housing in the attenuator dial cover.

ad. Loosen and remove the single screw, located between the two control shafts protruding from the attenuator dial cover, thereby removing the attenuator dial cover from its mounting on the Tuning Unit front panel.

ae. Remove the attenuator dial cover.

af. Set the FUNCTION SEL switch to ZERO SET.

ag. Adjust the power monitor meter ZERO SET control to obtain a power monitor meter pointer deflection of ZERO.

ah. Set the FUNCTION SEL switch to CAL SIG GEN.

ai. Adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL.

aj. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a microwave power meter reading corresponding to the low-power value determined in step v, above.

ak. Loosen the two setscrews which secure the -DBM MICROVOLTS dial to its shaft.

al. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control so that the -DBM MICROVOLTS dial 0 dbm mark lies beneath the power set indicator hairline.

am. Tighten the two setscrews to secure the -DBM MICROVOLTS dial to its shaft.

an. Recheck those frequencies covered in step v, above, for power output. At each frequency first zero-set the power monitor meter and then adjust the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection of CAL. Then adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the 0 dbm mark of the -DBM MICROVOLTS dial beneath the power set indicator hairline. Note the microwave power meter reading. It should read 0 dbm $\pm$ 2 db. To improve the accuracy of the signal calibrator output level, prepare calibration charts as outlined in the following additional steps.

1. At 100 mc increments, zero-set the power monitor meter and adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a microwave power meter indication of 0 dbm.

2. Adjust the SIGNAL CALIBRATOR POWER SET control to position the power set indicator directly above the 0 dbm mark of the -DBM MICROVOLTS dial.

3. Note the power monitor meter pointer deflection. Transfer this reading to a chart on which frequency is plotted along the abcissa and power monitor meter deflection is plotted along the ordinate. When using the signal calibrator, adjust the SIGNAL CALIBRATOR POWER SET control to the indication on the chart. This corresponds to a power monitor meter pointer deflection of "cal."

ao. To reset the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stops, proceed as outlined in the following additional steps.

1. Rotate the TUNING control to the low end of the band.

2. Rotate the SIGNAL CALIBRATOR POWER SET control to obtain a power monitor meter pointer deflection corresponding to "cal."

3. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to position the power set indicator hairline a distance corresponding to 1 db on the positive side of the -DBM MICROVOLTS 0 dbm mark. If this cannot be obtained, loosen the two setscrews on the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop yoke. Grasp the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control drive shaft with one hand and rotate it clockwise till the +1 dbm mark lies directly beneath the power set indicator hairline. With the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control drive shaft still grasped, rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop clockwise until it meets a positive stop. Then tighten the two SIGNAL CALIBRATOR OUTPUT ATTENUATOR stop setscrews.

ap. Replace the attenuator dial cover.

aq. Screw the attenuator dial cover to the Tuning Unit front panel.

ar. Replace the SIGNAL CALIBRATOR POWER SET knob on its shaft.

as. Tighten the two setscrews to secure the SIGNAL CALIBRATOR POWER SET knob to its shaft.

at. Replace the SIGNAL CALIBRATOR OUTPUT ATTENUATOR knob on its shaft.

au. Tighten the two setscrews to secure the SIGNAL CALIBRATOR OUTPUT ATTENUATOR knob on its shaft.

av. Replace the two pilot lights.

4-108. INPUT ATTENUATOR ASSEMBLY, TROUBLESHOOTING.

4-109. To troubleshoot the r-f input attenuator assembly, proceed as outlined in the following steps.

a. Disconnect the r-f cables associated with the input attenuator assembly and check them for continuity. Replace any defective cable.

b. Check the attenuation of each of the r-f attenuators. They should each have a nominal attenuation of 20 db. Replace any defective attenuator.

c. Check the operation of the coaxial r-f input attenuator switches. Replace if necessary.

d. Check the operation of coaxial r-f transfer switch S1101. Replace if necessary.

4-110. INPUT ATTENUATOR ASSEMBLY, CALIBRATION.

4-111. Replacement of any one of the five calibrated coaxial r-f input attenuators will require recalibration of that particular section of the input attenuator assembly containing the replacement attenuator. To recalibrate the input attenuator assembly, proceed as outlined in paragraph 2-22, steps a through v. Then proceed as outlined in the following additional steps.

a. Disconnect P326 from J326 of the 140-mc i-f attenuator subassembly.

b. Disconnect P325 from J325 of the 140-mc i-f attenuator subassembly.

c. Connect a standard calibrated i-f attenuator, using a 6-db 50-ohm pad at each end, between P326 and P325, as shown in figure 4-38.

d. Adjust the standard calibrated i-f attenuator so that

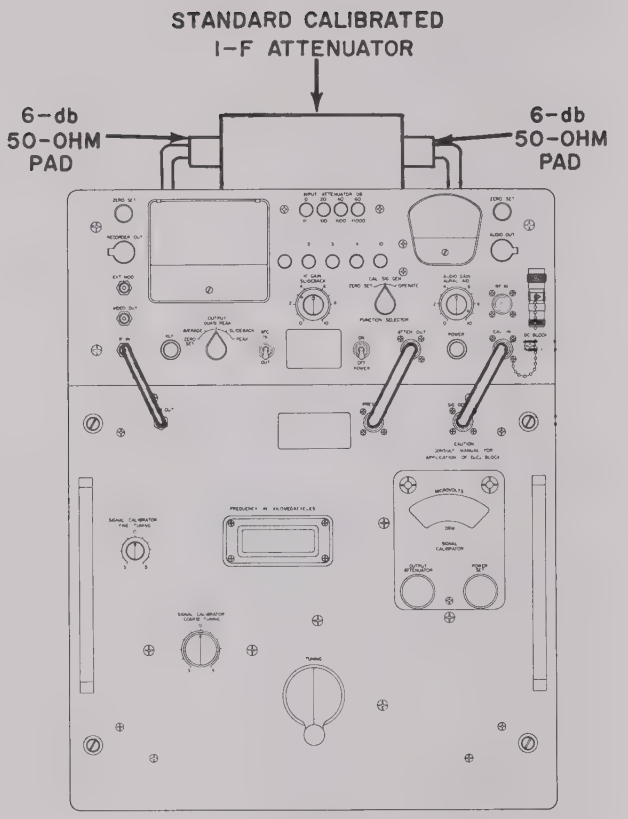


Figure 4-38. Calibrating Input Attenuator Assembly, Equipment Set Up

no i-f attenuation is inserted.

e. Depress the r-f INPUT ATTENUATOR DB push-button switch corresponding to that section of the input attenuator assembly repaired.

f. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain a reference deflection on the output meter scale. Note this deflection.

g. Note the -DBM MICROVOLTS dial indication on the -dbm scale.

h. Insert 20-db of calibrated i-f attenuation.

i. Depress the next lower r-f INPUT ATTENUATOR DB push-button switch.

j. Note the output meter pointer deflection.

k. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain the same output meter pointer deflection as in step f.

l. Through the use of the attenuator correction curves supplied with the Basic Unit, determine the db error of the replacement attenuator. Repeat the above steps for other frequency values throughout the band.

4-112. ALIGNING EXTERNAL MODULATION CIRCUIT.

4-113. To align the external modulation circuit of Basic Unit serial nos. 291, 294, 297, 298, 307 to 312, 315, 316, 321, 322, and 324 and up, proceed as outlined in paragraph 2-12, steps a through v. Then proceed as outlined in the following additional steps.

a. Disconnect r-f cable assembly W1205 from between the SIG GEN OUT jack and the CAL IN jack.

b. Adjust the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control to obtain an output level of 0 dbm, as indicated on the -DBM MICROVOLTS dial.

c. Connect a d-c oscilloscope, through a crystal detector, to the SIG GEN OUT jack.

d. Note the trace on the oscilloscope screen.

e. Set the FUNCTION SEL switch to ZERO SET.

f. Note the trace on the oscilloscope screen. The d-c level should differ from that of step d.

g. Adjust the oscilloscope vertical sensitivity to obtain a difference of three boxes between the levels of steps d and f.

h. Connect the positive probe of a d-c voltmeter between pin 19 of TB300 and ground.

i. Adjust Clipping Level Adj. control R389 to obtain a voltmeter indication of +40 volts.

j. Connect a pulse generator, adjusted for a positive pulse train output of 50 volts peak at 100 pps and a width of from 5 to 9 microseconds, to the EXT MOD jack.

k. Observe the oscilloscope display. The pulses should have a relatively flat bottom. Check for pulsing throughout the band. Repeat steps a through k for all other Tuning Units available. If any Tuning Unit cannot be pulsed, continue to step l.

l. Rotate the SIGNAL CALIBRATOR OUTPUT ATTENUATOR control fully counterclockwise and set the SIGNAL CALIBRATOR COARSE TUNING and SIGNAL CALIBRATOR FINE TUNING controls to 0.

m. If unable to pulse Tuning Unit, check signal calibrator reflector modes. If bad tilt appears on oscilloscope screen, increase the voltage at pin 19 of TB300.

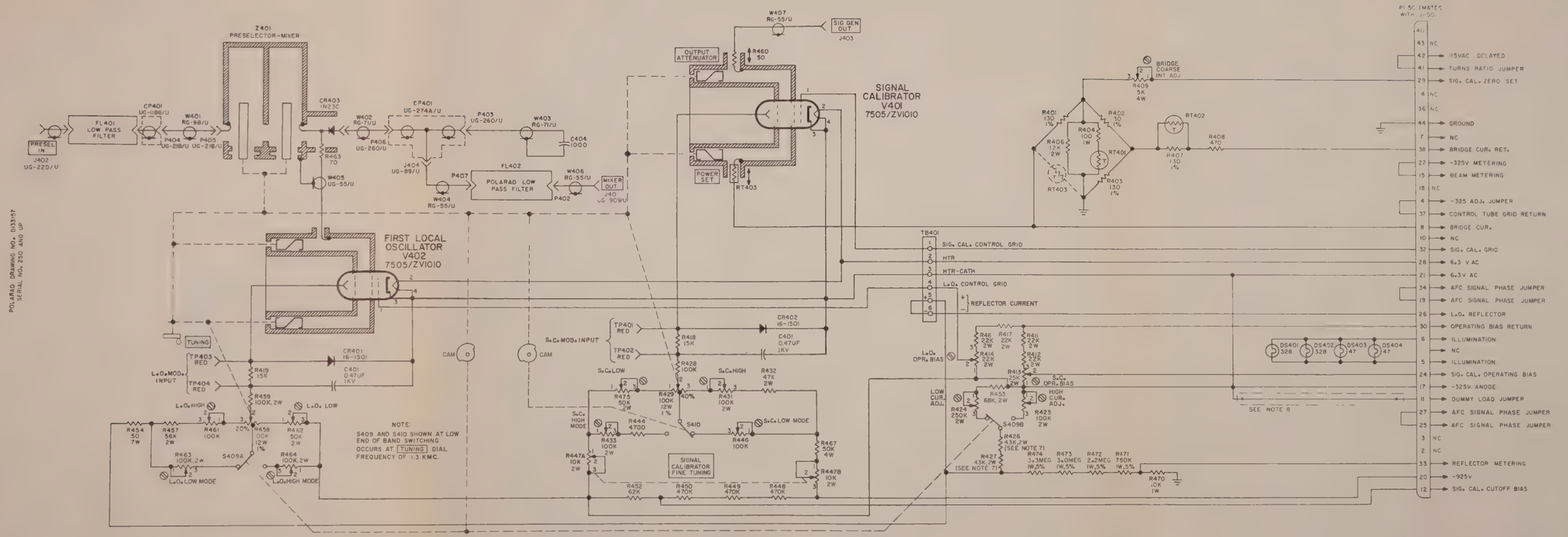
n. All four Tuning Units should now be capable of external pulse modulation. Should any Tuning Unit be unable to be pulsed, repeat the entire alignment procedure with that Tuning Unit installed in the Basic Unit.

SECTION V

DIAGRAMS

5-1. INTRODUCTION.

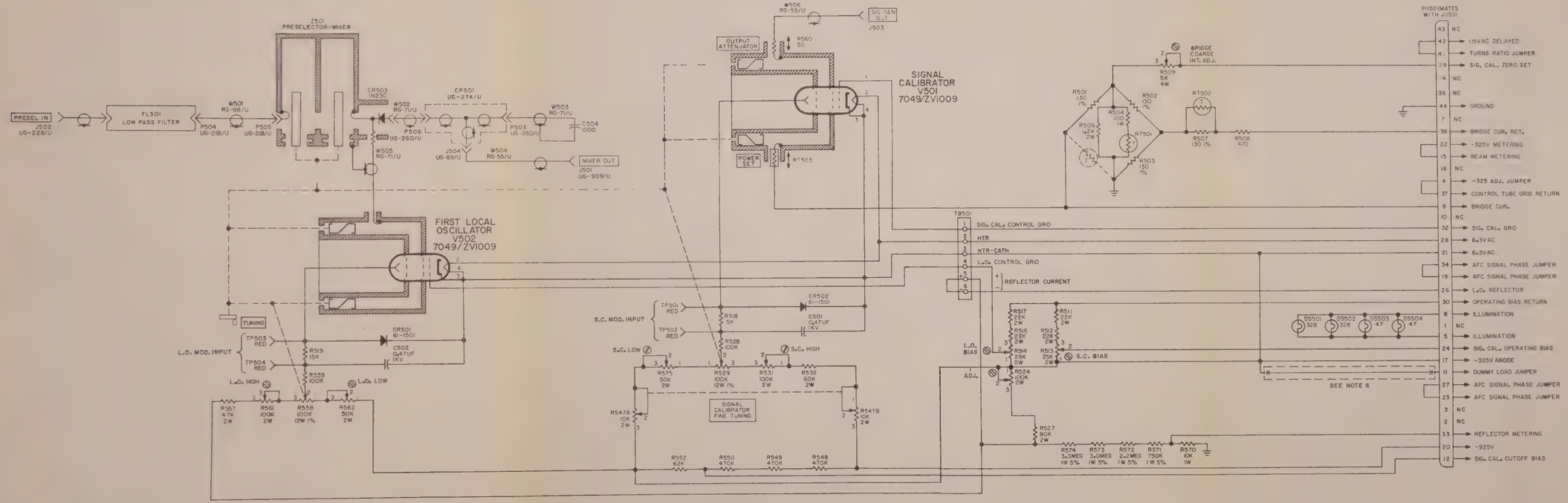
5-2. This section contains schematic diagrams which are of aid in the maintenance and repair of the FIM-2.



NOTES

1. ALL VALUES ARE EXPRESSED IN MICRO MICROFARADS (UUFD, MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM.
2. CAPACITORS ARE RATED AT ±10%, 400 VDCW, UNLESS OTHERWISE INDICATED.
3. INDUCTORS ARE RATED AT ±20%, 1000 VDC TEST, UNLESS OTHERWISE INDICATED.
4. RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED.
5. ▭ INDICATES EQUIPMENT PANEL CONTROL.
6. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
7. R426 AND R427 ARE 68K, 2WATT FOR SERIAL NOS 250 TO 275, 277 TO 290, 290 TO 299, 301, AND 303.
8. CONNECTION BETWEEN POINTS X-X NOT EMPLOYED IN SERIAL NOS 304 AND UP.

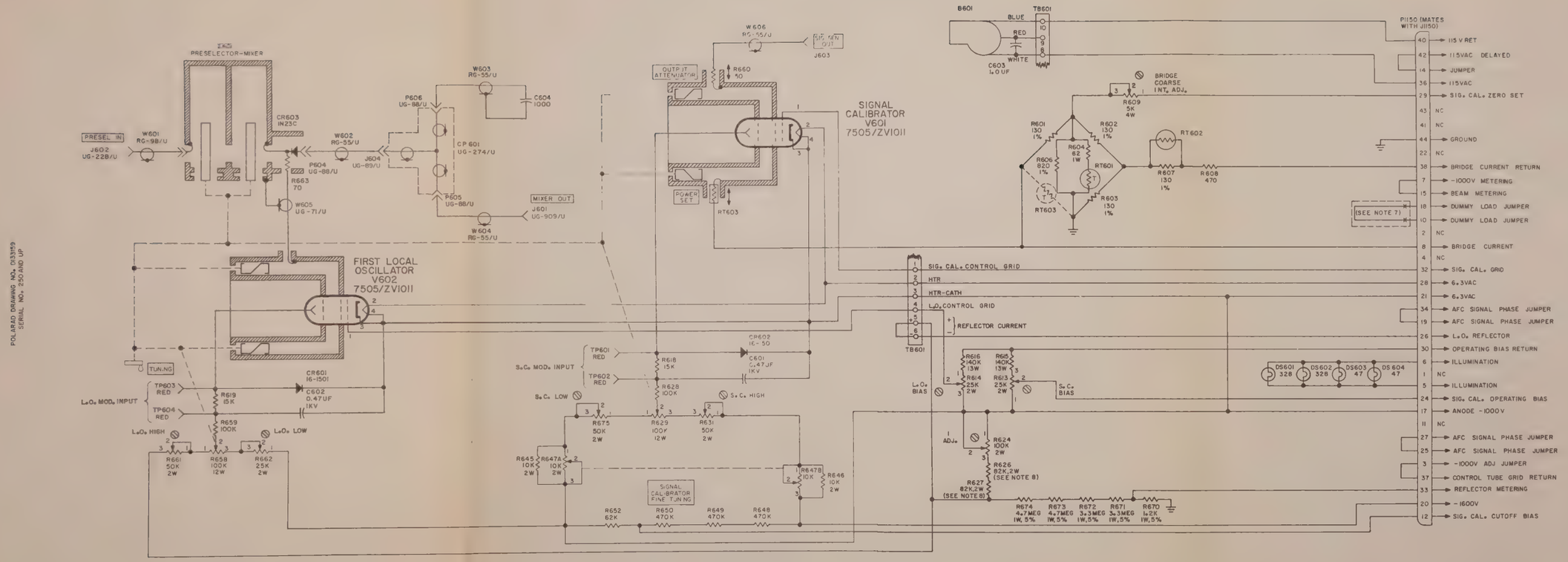
Figure 5-1. Model FIM-L2 Tuning Unit, Schematic Diagram



NOTES:

1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, K FOR KILOHM, OR MEG FOR MEGOHM
2. CAPACITORS ARE RATED AT ±10%, 400 WVDC, UNLESS OTHERWISE INDICATED
3. RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED
4. ▭ INDICATES EQUIPMENT PANEL MARKING
5. ⊘ INDICATES SCREWDRIVER ADJUSTMENT
6. CONNECTION BETWEEN POINTS X — X NOT EMPLOYED IN SERIAL NOS 304 AND UP

Figure 5-2. Model FIM-S2 Tuning Unit, Schematic Diagram



POLARAD DRAWING NO. 053159
SERIAL NO. 250 AND UP

NOTES

1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM.
2. CAPACITORS ARE RATED AT ±10%, 400 VDCW, UNLESS OTHERWISE INDICATED.
3. INDUCTORS ARE RATED AT ±20%, 1000 VDC TEST, UNLESS OTHERWISE INDICATED.
4. RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED.
5. ▭ INDICATES EQUIPMENT PANEL MARKING.
6. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
7. CONNECTION BETWEEN POINTS X-X NOT EMPLOYED IN SERIAL NOS. 304 AND UP.
8. R626 AND R627 ARE 75K, 2 WATT FOR SERIAL NOS. 250 TO 323.

Figure 5-3. Model FIM-M2 Tuning Unit, Schematic Diagram

POLARAD DRAWING NO. D133160
SERIAL NO. 250 AND UP

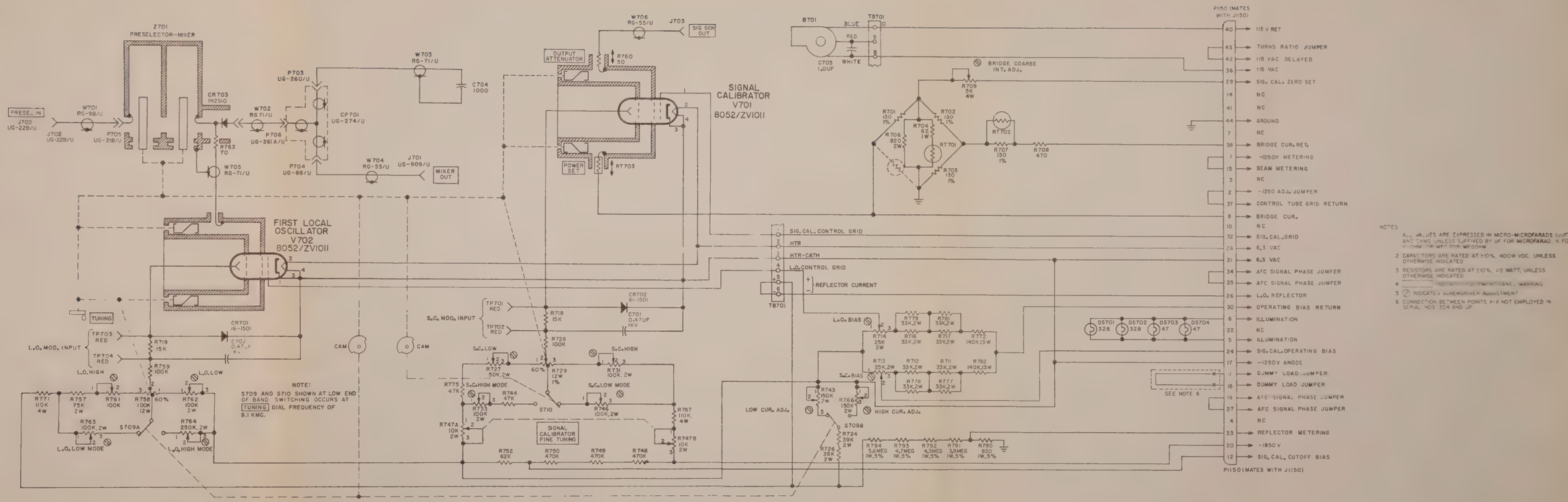
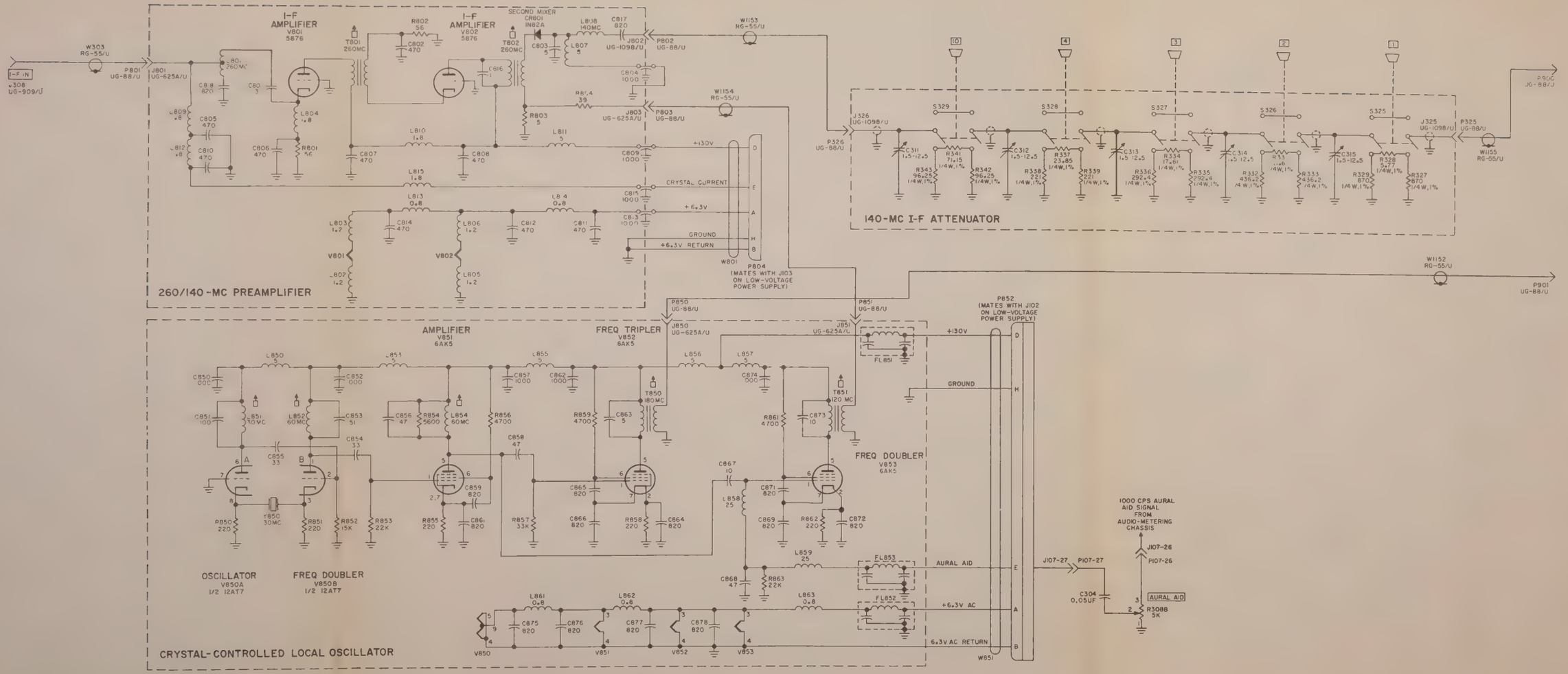
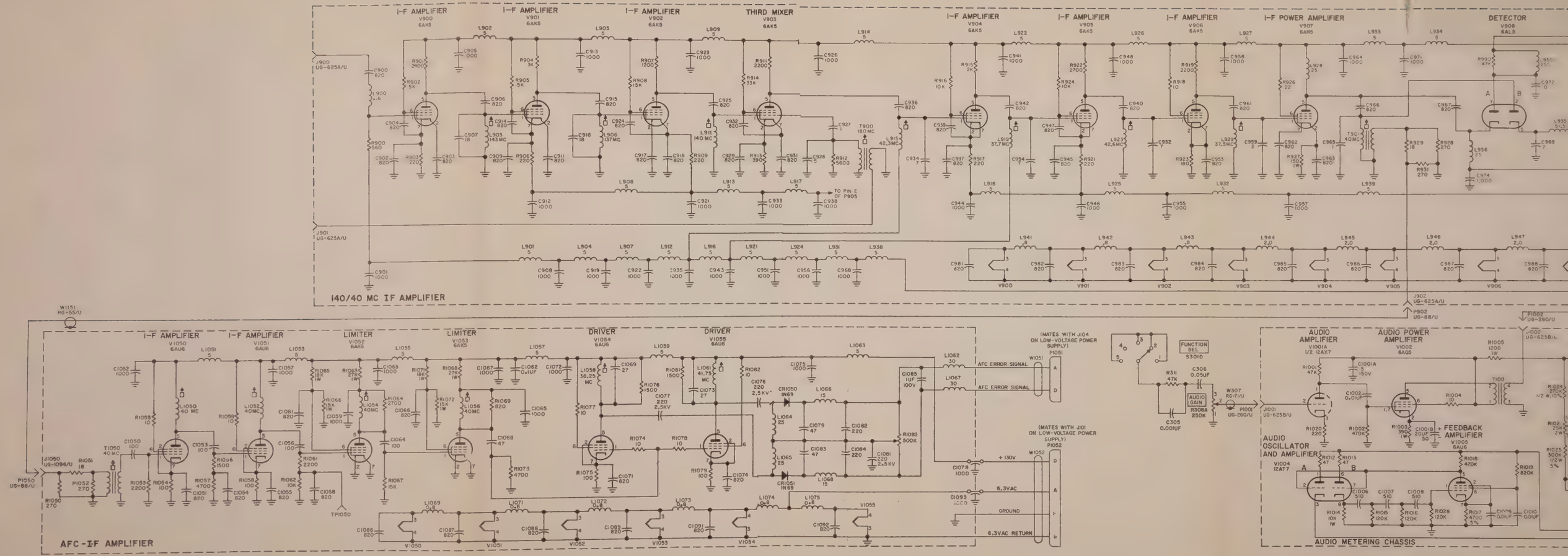
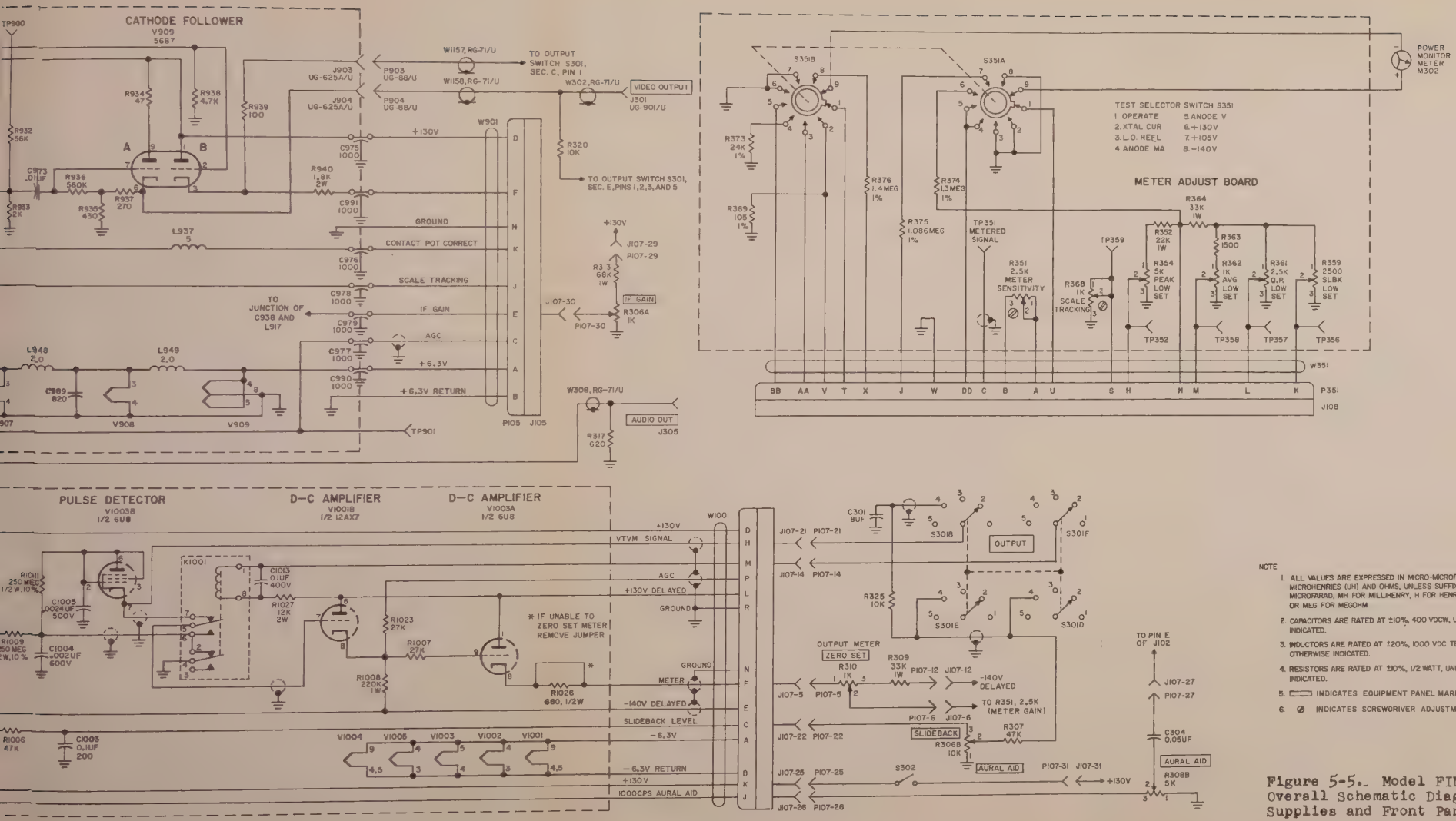


Figure 5-4. Model FIM-X2 Tuning Unit, Schematic Diagram



POLARAD DRAWING NO. J146131
SERIAL NOS 250 TO 323


I-F AMPLIFIER V900 6AK5
I-F AMPLIFIER V901 6AK5
I-F AMPLIFIER V902 6AK5
THIRD MIXER V903 6AK5
I-F AMPLIFIER V904 6AK5
I-F AMPLIFIER V905 6AK5
I-F AMPLIFIER V906 6AK5
I-F POWER AMPLIFIER V907 6AN5
DETECTOR V908 6AL5
J900 UG-625A/U
J901 UG-625A/U
J902 UG-625A/U
P902 UG-88/U
140/40 MC IF AMPLIFIER
TO PIN E OF P905
I-F AMPLIFIER V1050 6AU6
I-F AMPLIFIER V1051 6AU6
LIMITER V1052 6AK6
LIMITER V1053 6AK5
DRIVER V1054 6AU6
DRIVER V1055 6AU6
W1151 RG-55/U
P1050 UG-88/U
J1050 UG-1094/U
TP1050
AFC-IF AMPLIFIER
AFC ERROR SIGNAL
AFC ERROR SIGNAL
(MATES WITH J104 ON LOW-VOLTAGE POWER SUPPLY) P1051
W1051
(MATES WITH J101 ON LOW-VOLTAGE POWER SUPPLY) P1052
W1052
+ 130V
6.3VAC
GROUND
6.3VAC RETURN
FUNCTION SEL. S3010
AUDIO GAIN R308A 250K
W307 RG-71/U
P1001 UG-260/U
J1001 UG-625B/U
J1002 UG-625B/U
P1002 UG-260/U
AUDIO AMPLIFIER V1001A 1/2 12AX7
AUDIO POWER AMPLIFIER V1002 6AQ5
AUDIO OSCILLATOR AND AMPLIFIER V1004 12AT7
+ FEEDBACK AMPLIFIER V1005 6AU6
AUDIO METERING CHASSIS



NOTE

1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM
2. CAPACITORS ARE RATED AT ±10%, 400 VDCW, UNLESS OTHERWISE INDICATED.
3. INDUCTORS ARE RATED AT ±20%, 1000 VDC TEST, UNLESS OTHERWISE INDICATED.
4. RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED.
5. ▭ INDICATES EQUIPMENT PANEL MARKING
6. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.

Figure 5-5. Model FIM-B2 Basic Unit, Overall Schematic Diagram Less Power Supplies and Front Panel Circuitry

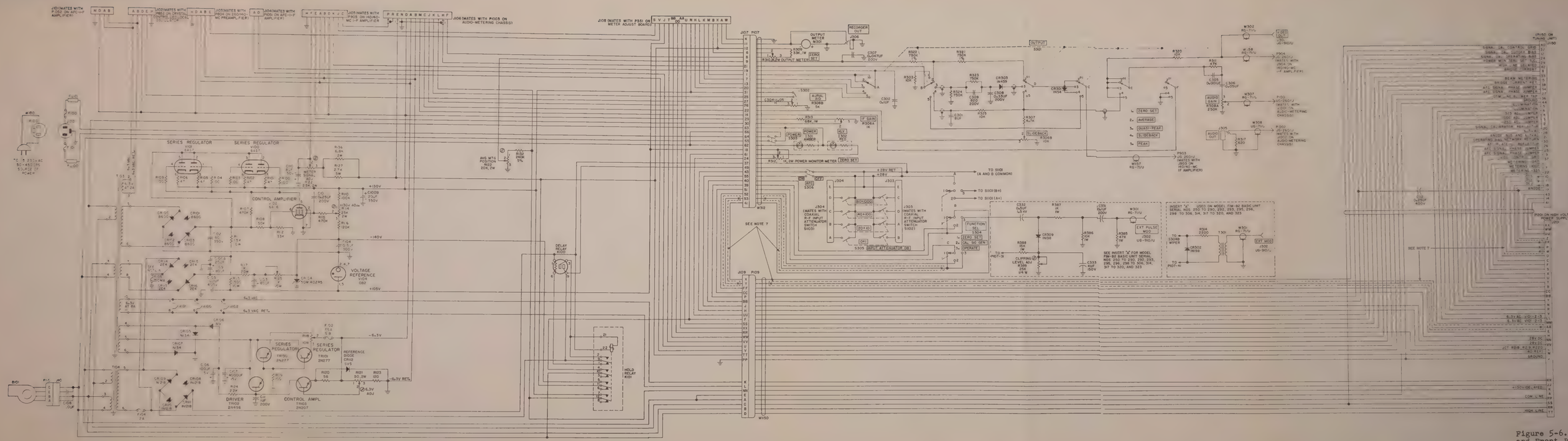


Figure 5-6. Low-Voltage Power Supply and Front Panel Circuitry, Schematic Diagram

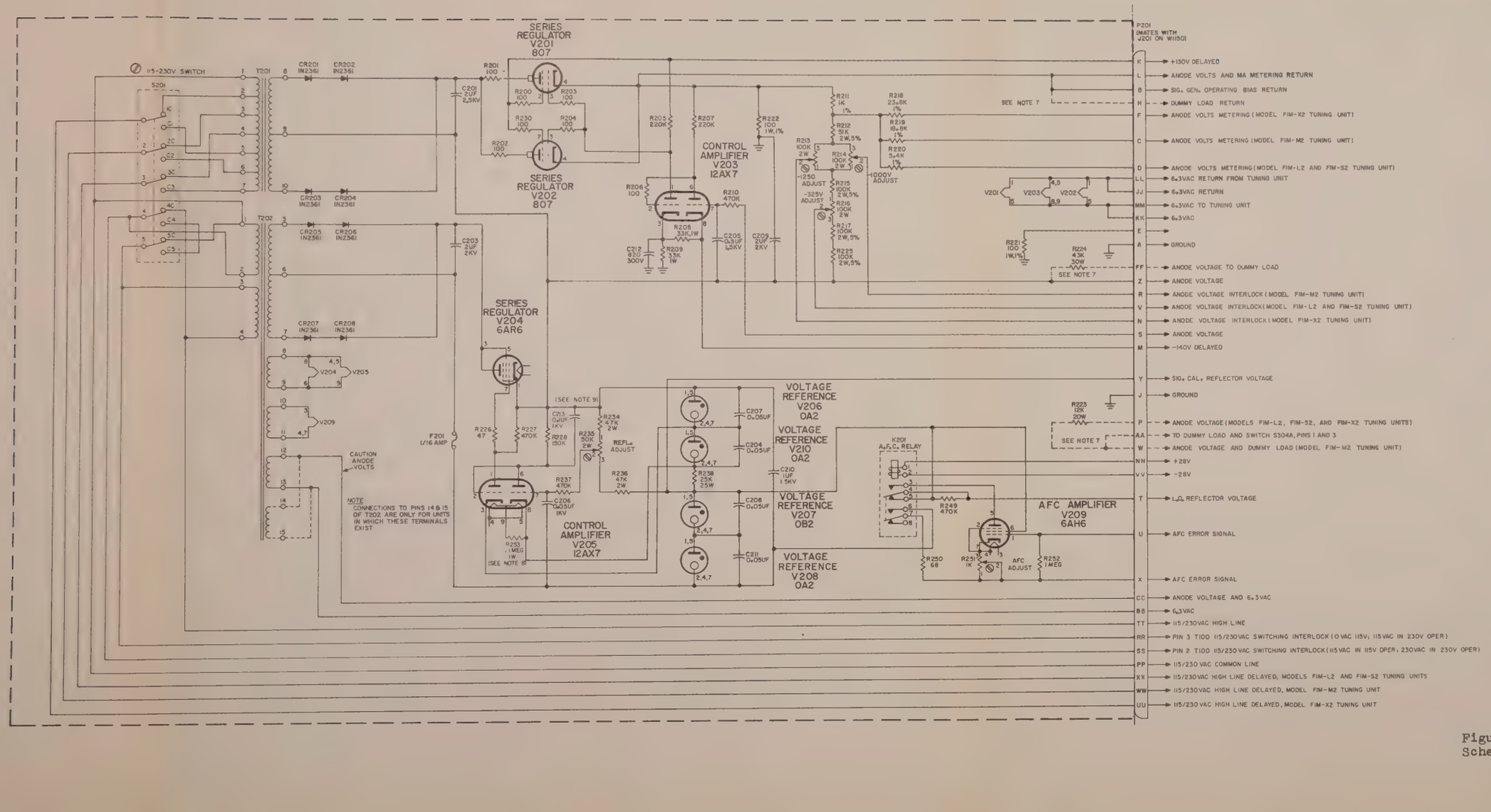
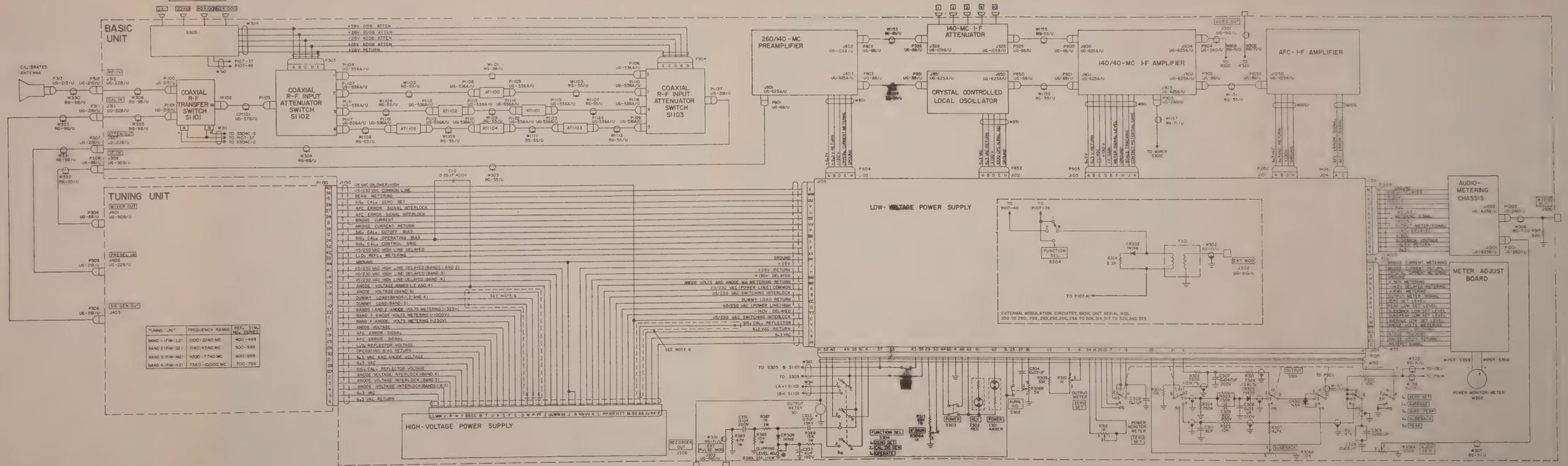

SERIES REGULATOR V201 807
SERIES REGULATOR V202 807
CONTROL AMPLIFIER V203 12AX7
SERIES REGULATOR V204 6AR6
CONTROL AMPLIFIER V205 12AX7
VOLTAGE REFERENCE V206 0A2
VOLTAGE REFERENCE V210 0A2
VOLTAGE REFERENCE V207 0B2
VOLTAGE REFERENCE V208 0A2
AFC AMPLIFIER V209 6AH6
K201 A.F.C. RELAY
115-230V SWITCH
S201
T201
T202
F201 1/16 AMP
CAUTION ANODE VOLTS
NOTE CONNECTIONS TO PINS 14 & 15 OF T202 ARE ONLY FOR UNITS IN WHICH THESE TERMINALS EXIST
REFL. ADJUST
AFC ADJUST
-1250 ADJUST
-325V ADJUST
-1000V ADJUST
SEE NOTE 7
SEE NOTE 8
P201 (MATES WITH J201 ON W1150)
K → +130V DELAYED
L → ANODE VOLTS AND MA METERING RETURN
B → SIG. GEN. OPERATING BIAS RETURN
H → DUMMY LOAD RETURN
F → ANODE VOLTS METERING (MODEL FIM-X2 TUNING UNIT)
C → ANODE VOLTS METERING (MODEL FIM-M2 TUNING UNIT)
D → ANODE VOLTS METERING (MODEL FIM-L2 AND FIM-S2 TUNING UNIT)
LL → 6.3VAC RETURN FROM TUNING UNIT
JJ → 6.3VAC RETURN
MM → 6.3VAC TO TUNING UNIT
KK → 6.3VAC
E →
A → GROUND
FF → ANODE VOLTAGE TO DUMMY LOAD
Z → ANODE VOLTAGE
R → ANODE VOLTAGE INTERLOCK (MODEL FIM-M2 TUNING UNIT)
V → ANODE VOLTAGE INTERLOCK (MODEL FIM-L2 AND FIM-S2 TUNING UNIT)
N → ANODE VOLTAGE INTERLOCK (MODEL FIM-X2 TUNING UNIT)
S → ANODE VOLTAGE
M → -140V DELAYED
Y → SIG. CAL. REFLECTOR VOLTAGE
J → GROUND
P → ANODE VOLTAGE (MODELS FIM-L2, FIM-S2, AND FIM-X2 TUNING UNITS)
AA → TO DUMMY LOAD AND SWITCH S304A, PINS 1 AND 3
W → ANODE VOLTAGE AND DUMMY LOAD (MODEL FIM-M2 TUNING UNIT)
NN → +28V
VV → -28V
T → L.O. REFLECTOR VOLTAGE
U → AFC ERROR SIGNAL
X → AFC ERROR SIGNAL
CC → ANODE VOLTAGE AND 6.3VAC
BB → 6.3VAC
TT → 115/230VAC HIGH LINE
RR → PIN 3 T100 115/230VAC SWITCHING INTERLOCK (0 VAC 115V; 115VAC IN 230V OPER)
SS → PIN 2 T100 115/230VAC SWITCHING INTERLOCK (115VAC IN 115V OPER; 230VAC IN 230V OPER)
PP → 115/230 VAC COMMON LINE
XX → 115/230VAC HIGH LINE DELAYED, MODELS FIM-L2 AND FIM-S2 TUNING UNITS
WW → 115/230VAC HIGH LINE DELAYED, MODEL FIM-M2 TUNING UNIT
UU → 115/230 VAC HIGH LINE DELAYED, MODEL FIM-X2 TUNING UNIT
NOTES
1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF), MICROHENRIES (UH) AND OHMS, UNLESS SUFFIXED BY UF FOR MICROFARAD, MH FOR MILLIHENRY, H FOR HENRY, K FOR KILOHM, OR MEG FOR MEGOHM
2. CAPACITORS ARE RATED AT ±10%, 400 VDCW, UNLESS OTHERWISE INDICATED.
3. INDUCTORS ARE RATED AT ±20%, 1000 VDC TEST, UNLESS OTHERWISE INDICATED.
4. RESISTORS ARE RATED AT ±10%, 1/2 WATT, UNLESS OTHERWISE INDICATED.
5. ▭ INDICATES EQUIPMENT PANEL MARKING
6. ● INDICATES SCREWDRIVER ADJUSTMENT
7. EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS. 250 TO 323 ONLY.
8. R253 EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS. 304 AND UP
9. C213 EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS. 294 AND UP

Figure 5-7. High-Voltage Power Supply, Schematic Diagram


BASIC UNIT
TUNING UNIT
COAXIAL R-F TRANSFER SWITCH S1101
COAXIAL R-F INPUT ATTENUATOR SWITCH S1102
COAXIAL R-F INPUT ATTENUATOR SWITCH S1103
260/140-MC PREAMPLIFIER
140-MC I-F ATTENUATOR
140/40-MC I-F AMPLIFIER
AFC-I-F AMPLIFIER
CRYSTAL CONTROLLED LOCAL OSCILLATOR
LOW-VOLTAGE POWER SUPPLY
HIGH-VOLTAGE POWER SUPPLY
AUDIO-METERING CHASSIS
METER ADJUST BOARD
CALIBRATED ANTENNA
INPUT ATTENUATOR DB
+28V 60DB ATTEN
+28V 20DB ATTEN
+28V 40DB ATTEN
+28V 60DB ATTEN
+28V RETURN
TUNING UNIT | FREQUENCY RANGE | REFL. SYM. NO. SERIES
BAND 1 (FIM-L2) | 1000-2240 MC | 400-499
BAND 2 (FIM-S2) | 2140-4340 MC | 500-599
BAND 3 (FIM-M2) | 4200-7740 MC | 600-699
BAND 4 (FIM-X2) | 7360-12000 MC | 700-799
FUNCTION SEL S304
ZERO SET
CAL
OPERATE
OUTPUT METER S301
POWER S303
POWER S302
AURAL A/D S302
POWER MONITOR METER S302
EXTERNAL MODULATION CIRCUITRY, BASIC UNIT SERIAL NOS. 250 TO 290, 292, 293, 295, 296, 298 TO 306, 314, 317 TO 320, AND 323.

NOTES:

1. ALL VALUES ARE EXPRESSED IN MICRO-MICROFARADS (UUF) AND OHMS, UNLESS SUFFIXED BY UF, FOR MICROFARAD, K, FOR KILOHM, OR MEG FOR MEGOHM.
2. CAPACITORS ARE RATED AT 200 WVDC, UNLESS OTHERWISE INDICATED.
3. RESISTORS ARE RATED AT ±10%, ½ WATT, UNLESS OTHERWISE INDICATED.
4. ⟋ INDICATES EQUIPMENT PANEL MARKING.
5. ⊘ INDICATES SCREWDRIVER ADJUSTMENT.
6. CONNECTIONS BETWEEN POINTS ⟋⟋ NOT EMPLOYED IN MODEL FIM-B2 BASIC UNIT SERIAL NOS. 324 AND UP.

Figure 5-8. Model FIM-2 System Interconnecting Cabling Diagram

POLARAD ELECTRONICS CORP.

CONSULTANTS — DESIGNERS — MANUFACTURERS
43-20 34th Street Long Island City 1, N. Y.
EXeter 2-4500

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL _____

_____ POSITION _____

SECTION OR DIVISION _____ PHONE NO. _____ EXT. _____

EQUIPMENT _____ DATE OF PURCHASE _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date trouble occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional Comments: _____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics Corporation
43-20 34th Street
Long Island City 1, New York
ATTENTION: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will so notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

POLARAD

ELECTRONICS CORPORATION
43-20 34th Street
Long Island City 1, New York

World Leader in Microwave Instrumentation

SPECTRUM ANALYZERS—10-100,000 MC

Undisputed leader in the field of microwave spectrum analysis, Polarad offers the widest, most diversified line of equipments for precise and meaningful quantitative and qualitative evaluation of any signal, regardless of complexity or frequency content. The features listed below are generally common to all Polarad Spectrum Analyzers:

- Direct-reading UNIDIAL® tuning —no klystron mode-setting!
- Frequency Dial Accuracy, ±1%
- Sweep-rate adjustable, 1-30 cps
- Non-contacting klystron-cavity chokes for noiseless tuning, optimum stability
- Five-inch flat-face CRT display
- Compatible with Multi-pulse Spectrum Selector SD-1

Model TSA-S
Dual-Purpose Spectrum Analyzer/ Synchroscope

TSA SERIES. 10-44,000 MC in 5 plug-in tuning units. Model TSA provides power vs. freq. display (A), below. Model TSA-S provides both (A) and synchroscope display (B). Wide-dispersion Model TSA-W provides (A) display, up to 80 MC (full screen), down to 60 KC for wide pulse analysis, as in (C).

MODEL	DISPERSION	RESOLUTION	MARKER	NOTES
TSA	25 KC-25 MC	1-80 KC	±14 MC	Sensitivity —50 to —100 dbm
TSA-S	400 KC-25 MC	5/50/500 KC and 5 MC	±14 MC	Sensitivity —50 to —100 dbm. Synch. Sweep Rates: 2 μsec to 0.1 sec/cm
TSA-W	25 KC-80 MC	1-80 KC	±40 MC	Sensitivity —50 to —100 dbm Displays spectra of 0.1 μsec pulses

Model SA-84W
Wide-Band Spectrum Analyzer

SA SERIES Universal Spectrum Analyzers provide complete coverage from 10-40,880 MC in compact, self-contained form. The new lightweight transistorized unit Model SA-84T is truly portable, and will operate from either the AC line or 12 V DC. The SA-84W wide-band design features exceptionally broad frequency coverage and very wide dispersion in a single-unit package.

Model SA-84T
Transistorized Portable

MODEL	DESCRIPTION	DISPERSION	RESOLUTION	NOTES
SA-84T	Transistorized Universal	400 KC-25 MC adjustable	20 KC	Internal Marker, ±13 MC Sensitivity, —50 to —105 dbm.
SA-84	Standard Universal	500 KC- 5 MC (up to 55 MC) 500 KC-25 MC (above 55 MC) adj.	20 KC	Variable Internal Marker comparable sensitivity to SA-84T
SA-84W	Wide-Dispersion Universal	25 KC-10 MC 25 KC-80 MC 240 to 40,880 MC	1-80 KC variable	Crystal-controlled markers over entire freq. range. Log-linear display. Accurate IF attenuator. Comparable sensitivity to SA-84T

MULTI-PULSE SPECTRUM SELECTOR: When used with any Polarad Spectrum Analyzer, this instrument permits isolation and spectrum analysis of any individual pulse in a complex coded signal.

Model SD-1

MODEL DA-70, 50-100 KMC Spectrum Analyzer. Dispersion adj. 50-1000 MC. Resolution 1 MC. High IF assures image rejection, prevents video detection. Sensitivity, —50 dbm, nom. Frequency marker for ΔF measurements.

MODEL WSA Wide-Band Spectrum Analyzer. 10-40,000 MC in 20 push-button-selected bands. Narrow mode: 1-25 MC dispersion, 20 KC resolution. Wide mode: 50-4,000 MC dispersion, 1.5 MC resolution. Freq. marker to 4 KMC. End-markers indicate band limits. Center-marker for wide-to-narrow switching without signal loss.

Model WSA

USE THIS CARD for complete specifications or call your local Polarad representative (see the Yellow Pages).

SIGNAL GENERATORS—0.5-50 KMC

Model PMR
UHF Signal Generator

MSG-2R
Signal Generator

Model MSG-34
Ultra-Broadband Signal Generator

500-11,000 MC SERIES. These superb instruments incorporate every important mechanical and electronic advancement known to the art, including several Polarad exclusives, such as UNIDIAL® tuning. Direct-reading frequency dials, accurate to ±1%. High-stability non-contacting klystron-cavity shorts for noiseless tuning, permanent accuracy. Continuously-variable, directly-calibrated attenuators. Modulation: internal pulse, FM, sq-wave; external pulse and multi-pulse. Delayed and undelayed sync. outputs. The Model PMR provides exceptional FM capability through the use of a special plug-in modulator (supplied).

MODEL	FREQUENCY-KMC	CALIBRATED POWER OUTPUT	INTERNAL MODULATION
PMR	0.5 - 1.0	0.5 MW (—3 dbm) to —127 dbm	sq-wave, 40-4,000 pps } FM with plug-in Pulse, 10-10,000 pps } modulator
KSS (Signal Source)	1.05-11.0 (4 plug-ins)	Uncalibrated. Power Output: 14-400 MW, depending on freq.	sq-wave, 10-10,000 pps (external pulse, sq-wave, FM)
PMX	4.45-11.0 (2 plug-ins)	1 MW (0 dbm) to —127 dbm	All instruments in this group: pulse modulation: 10-10,000 pps. *pulse width: 0.2-10 μsec. pulse delay: 2-2,000 μsec. square-wave modulation: 10-10,000 pps. FM deviation: ±2.5 MC min. *0.3-10 μsec. in MSG-1R and 2R.
MSG-34 (Ultra Broadband)	4.2 -11.0 digital freq. indicator	1 MW (0 dbm) to —127 dbm	
MSG-1R	0.95- 2.40	1 MW (0 dbm) to —127 dbm	
MSG-2R	2.0 - 4.60	1 MW (0 dbm) to —127 dbm	

MULTI-PULSE CODE-MODULATED MICROWAVE SIGNAL GENERATOR

Model B — 0.95 to 10.75 KMC 4 plug-in tuning units. 5 independent adjustable channels, each with variable pulse width and delay. Built-in precision scope.

EHF SERIES Signal Generators (frequency and power calibrated) and Signal Sources (frequency calibrated) operate CW, with 1 KC int. modulation, or ext. mod'n. See chart for tuning unit ranges and designations. Also available: SG-1218 Generator or SS-1218 Source, 12.4-17.5 KMC.

EHF Series
Signal Generators

EHF SIGNAL GENERATOR Tuning Unit	Frequency Range	EHF SIGNAL SOURCE Tuning Unit
G1822-1	18,000 to 22,000 mc	S1822-1
G2225-1	22,000 to 25,000 mc	S2225-1
G2427-1	24,700 to 27,500 mc	S2427-1
G2730-1	27,270 to 30,000 mc	S2730-1
G3033-1	29,700 to 33,520 mc	S2933-1
G3336-1	33,520 to 36,250 mc	S3336-1
G3540-1	35,100 to 39,700 mc	S3540-1
	39,600 to 46,000 mc	S4046-1
	45,900 to 50,000 mc	S4650-1

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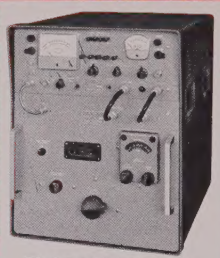
World Leader in Microwave Instrumentation

MICROWAVE RECEIVERS & FIELD INTENSITY METERS, 0.4—84.2 KMC

Polarad, pioneer in microwave receiver development, offers the industry's most complete and diversified line of precisely-calibrated, wide-range receivers and radio-interference-and-field-intensity(RI/FI)meters. The new transistorized portables feature built-in inverters for optional 12 VDC operation. **Only Polarad** offers **both** calibration techniques: Integral signal generator (Model FIM-2) for wide-range, absolute level calibration **or** (Model CFI) integral impulse generator for simplicity, convenience. All units have audio, video, and recorder outputs. All display output directly in db.

Model CFI Portable Transistorized Calibrated RI/FI — Meter/Receiver

Model R Wide-Range Multipurpose Microwave Receiver



Model FIM-2 Absolute-Calibrated RI/FI—Meter/Receiver

Model TR Transistorized Portable Wide-Range Multipurpose Receiver

Both the CFI and FIM-2 have Category A Air-Force Approval Per MIL-I-26600 and MIL-I-6181

MODEL	DESCRIPTION	FREQUENCY RANGE	MINIMUM SENSITIVITY ⑥	SELECTIVITY & TUNING (see notes below)	CHARACTERISTICS
CFI	TRANSISTORIZED CALIBRATED RI/FI METER/RECEIVER (Category A AF approved)	1-10 KMC (0.95-11.26 as receiver)	—90 to —84 dbm	① ② ③ ④	• **Digital** frequency dial • AM, FM, CW, Pulse reception • AFC, AGC (60 db linearity range!) • Calibrated antenna system includes both omni (broad-band) and directionals for each range. • Attenuation: 0-80 db in 1 db steps • Front panel metering of average, peak, slide-back peak, or quasi-peak RF level.
FIM-2	CALIBRATED RI/FI METER/RECEIVER (Category A AF approved)	1-10 KMC Check Polarad for 21 KMC Coverage.	—81 dbm	① ② ③ ④	• Single UNIDIAL® tunes both receiver and signal generator. • First system to determine radiated RF interference and susceptibility.
TR	TRANSISTORIZED MICROWAVE RECEIVER	0.95-11.26 KMC	—90 dbm	① ③ ④ ⑤	• AFC, AGC circuits. • **Digital** frequency dial • AFC, AGC (60 db linearity range!) These versatile precision devices are really **four instruments in one:** • AM, FM, CW, MCW, Pulse Receiver. • Field-intensity receiver. • Pulse, pulse-time position demodulator. • Sensitive power meter.
R	ULTRA-WIDE-BAND MICROWAVE RECEIVER	0.4-84.2 KMC	—85 to —50 dbm	② ③ ⑤	• UNIDIAL® direct-reading freq. control • AFC, AGC (60 db linearity range!)

① Impulse Bandwidth: 1, 5, or 8 mc (Model FIM-2, 5MC only).
② Image and Spurious Response Rejection: better than 60 db. (up to 11.26 KMC in Model R)
③ Four plug-in tuning units cover entire range (Model R uses 9) and all are direct-reading, calibrated to ±1%.
④ Maximum RF input, 3 Volts.
⑤ Video bandwidth: 3.5 MC (Model TR) 2 MC (Model R)
⑥ Depending upon frequency.

ANTENNA PATTERN TUNING UNIT 2-75 KMC: Used with Model R receiver. External Mixer with flexible cable. Locate up to 75 ft. from receiver, at or near antenna. Internal 1 KC sweep — compatible with all standard AC recorders.

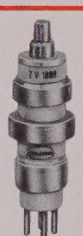
Model RW-T

CALIBRATED ANTENNAS
1,000 to 10,000 MC

TEST ANTENNAS
1,000 to 40,000 MC

TRANSISTORIZED IMPULSE GENERATOR Model IC-120: 1 MC-10 KMC. Calibrates microwave receivers for RI/FI work. Signal source for spectrum analyzers. Generates 0.02 nanosec. pulses.

ALL-CERAMIC REFLEX KLYSTRONS Maximum resistance to shock, vibration, temperature extremes. Guaranteed operation to 250°C, without cooling. Stable, low noise, low microphonics. (X series has guaranteed minimum 200 mw output.) Request complete application data.



TYPE	FREQ. RANGE—KMC	RETMA
ZV1012	0.5 - 3.0	7506
ZV1010	0.7 - 3.0	7505
ZV1010X	0.95- 2.8	——
ZV1021	1.0 - 4.0	——
ZV1021X	1.0 - 4.0	——
ZV1009	1.5 - 6.0	7049
ZV1009X	1.7 - 5.0	——
ZV1011	4.0 -11.0	8052

SPECIAL INSTRUMENTATION for MICROWAVE DEVELOPMENT, PRODUCTION, CHECKOUT.

Condensed listing of precision instruments developed by Polarad to meet a wide range of requirements.

Model MP-1A
Five-Channel Coded Multipulse Generator

CODED MULTI-PULSE GENERATOR. Model MP-1A. Five independently adjustable channels generate coded multipulse trains. Permits independent external PTM of each channel. 10-10,000 cps group rep-rate, each pulse adj. 0.2-2 μsec. Delay, 0-300 μsec.

PULSE JITTER TESTER. Model PJ-1. Measures and displays magnitude and waveform of:
Relative jitter: 5/10/100 nanosec. full scale
Pulse-width jitter: 5/10/100 nanosec. full scale
Rep-rate jitter: 5/10/100 nanosec, 1/10/100 μsec. full scale

PRECISION NOISE GENERATOR. Model N-1. 1KC-500MC source for direct measurement of noise figure (1-20 db, accurate to ±0.25 db) of VT and transistor circuits.

TRANSISTORIZED MICROWAVE POWER METER. Model P-3. Measures absolute power instantly, directly, 10-40,000 MC with 5 interchangeable thermistor mounts. 0.01 MW full scale sensitivity. Line or battery operated, only 6 lbs.

MICROWAVE TUBE TESTER. Model K-200. Simple as conventional tube tester, monitors cathode, anode, grid, reflector voltages and currents, checks shorts, fil. continuity. Tests klystrons (internal/external-cavity) pencil triodes, rocket and lighthouse tubes.

BG-6789

I would like more information and specifications on: (circle)

SPECTRUM ANALYZERS
TSA SA-84 DA-70
TSA-S SA-84T WSA
TSA-W SA-84W SD-1

SIGNAL GENERATORS
PMR MSG-1R EHF
MSG-34 MSG-2R KSS
PMX B

RECEIVERS and RI/FI METERS
R RW-T CFI
TR FIM-2 IC-120
ANTENNAS

LABORATORY EQUIPMENT
PJ-1 P-3 MP-1A
N-1 KLYSTRONS K-200

Name.....Title.....

Dept. or Station.....Company.....

Address.....

City.....Zone.....State.....

My major fields of interest and activity are:.....

.....

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ARKANSAS
LOUISIANA
OKLAHOMA
TEXAS
NEW MEXICO

Industrial Associated Electronics
8815 Diplomacy Row
Dallas 7, Texas
Melrose 1-2760

Industrial Associated Electronics
Room 2018
International Airport Terminal
El Paso, Texas
Prospect 2-2441 — 2-6063

ILLINOIS
INDIANA
WISCONSIN

Loren F. Green & Associates
5218 West Diversey Avenue
Chicago, Illinois
Avenue 6-6824

OHIO
WESTERN PA.
MICHIGAN

Harvey Teplitz & Co.
3718 Salem Avenue
Dayton 6, Ohio
Crestview 7-9178

Harvey Teplitz & Co.
671 Sycamore Drive
Cleveland, Ohio
Redwood 1-5676

Harvey Teplitz & Co.
19942 Inkster Road
Detroit 19, Michigan
Kenwood 7-9058

ALABAMA
FLORIDA
GEORGIA
MISSISSIPPI
N. CAROLINA
S. CAROLINA
TENNESSEE

Murphy and Cota
2110 Peachtree Road, N.W.
Atlanta 5, Ga.
Trinity 6-3020

Murphy and Cota
1106 Burke Street
Winston-Salem, N.C.
Park 4-0750

Murphy and Cota
712 W. Vasser Avenue
Orlando, Fla.
Garden 4-2167

Murphy and Cota
250 Governors Drive
Huntsville, Ala.
Jefferson 6-9121

NEW ENGLAND

George Gregory Associates
7 Erie Drive
Natick, Mass.
Olympic 5-1330

George Gregory Associates
9 South Main Street
Cheshire, Conn.
Atwater 8-2900

MISSOURI
KANSAS
IOWA
NEBRASKA

Engineering Services Co.
7546 Troost
Kansas City, Mo.
Emerson 1-9600

Engineering Services Co.
6717 Vernon Avenue
St. Louis, Mo.
Parkway 6-2233

Engineering Services Co.
4710 East Mt. Veron Rd.
Wichita 18, Kansas
Murray 3-3751

Engineering Services Co.
1026 Third Ave., S.E.
Cedar Rapids, Iowa
Empire 5-6183

METROPOLITAN
NEW YORK CITY

Eastern Instrumentation, Inc.
350 Northern Blvd.
Great Neck, New York
466-9505

VIRGINIA
WASHINGTON, D.C.
WEST VIRGINIA

Brimberg Associates
1343 H. Street N.W.
Washington 5, D.C.
Di-7-4234

MARYLAND
SOUTH NEW JERSEY
EASTERN PENNSYLVANIA

Eastern Instrumentation, Inc.
613 West Cheltenham Avenue
Philadelphia 26, Pa.
Waverly 7-6269

Eastern Instrumentation, Inc.
808 Ingleside Avenue
Baltimore 28, Md.
Ridgeway 4-3675

Eastern Instrumentation, Inc.
8616 Georgia Avenue
Silver Springs, Md.
Juniper 9-0100

NEW YORK STATE
(EXCEPT METROPOLITAN
NEW YORK)

Naco Electronics
119 Luther Avenue
Liverpool, N.Y.
GR 4-7481

Naco Electronics
74 Park Avenue
Rochester, N.Y.
Greenfield 3-4169

Naco Electronics
Stanley Theater Bldg.
261 Genesee Street
Utica, N.Y.
Redwood 2-3151

COLORADO
UTAH
WYOMING
MONTANA

McLoud & Raymond
2151 South Grape Street
Denver 22, Colorado
Skyline 6-1589 — 6-1580

McLoud & Raymond
4220 MacKay St.
Salt Lake City, Utah
Am 6-5002

OREGON
WASHINGTON
IDAHO

Hawthorne Electronics
700 S.E. Hawthorne Blvd.
Portland, Oregon
Belmont 4-9375

Hawthorne Electronics
Room 112 Administration Bldg.
Boeing Field
Seattle, Washington
Parkway 5-1460

DOMINION
OF
CANADA

Measurement Engineering Ltd.
P.O. Box 1352
Station O
Montreal, Quebec, Canada
National 7-4313

Mel Sales Ltd.
71 Crockford Blvd.
Scarborough, Toronto

OVERSEAS REPRESENTATIVES

ARGENTINA

Tecnitron
Charcas 1337
Buenos Aires

AUSTRALIA

Electronic Industries
Imports Pty Ltd.
139/143 Bouverie St.
Carlton, N. 3, Melbourne

AUSTRIA

INGLOMARK
Markowitsch & Co.
Mariahilfer Str 133
Vienna XV

BENELUX
I.R.C.A.
Paradysstraat 92
Voorburg, Holland

BRAZIL

Emile H. Staub, S.A.
Caixa Postal 4612
Sao Paulo

CHILE

Fred Muller, SAC.
Casilla Coreo 3844
Santiago

CHINA

Heighten Scientific Co.,Ltd.
49, South Yen-Ping Road
Taipei, Taiwan

DENMARK

Ditz Schweitzer
Bredgade 37
Copenhagen

ENGLAND

B & K Laboratories, Ltd.
4, Tilney Street, Park Lane
London W. 1

FINLAND

Orbis O/y
P.O. Box 16015
Helsinki — Toolo

FRANCE

Bureau de Liaison
113 Rue de L'Universite
Paris 7e

GERMANY

Rohde & Schwarz Vertriebs GMbH
Zweigniederlassung
Hohe Strasse 160-168
Koln

GREECE

Ev. D. Devletoglou
44 Eleftheriou Venizelou
Athens

ICELAND

Elding Trading Company
Hasnarhvoli
Reykjavik

INDIA

Motwane Pvt. Ltd.
P.O. Box 1312
Bombay 1

INDONESIA

Bah Bolon Trading Co., NW
Djalan Linggawastu St. 16
Bandung

ISRAEL

Electronic Equipment
6, Ibn Gvirol
Tel-Aviv

ITALY

Bay & Co., S.P.A.
Via Fabio Filzi N. 24
Milano (506)

JAPAN

Marubun Co., Ltd.
No. 1, 2-Chome
Odenmacho, Nihonbashi
Chuo-Ku, Tokyo

KOREA

Chung Do Industrial Co., Ltd.
P.O. Box No. 1451 International
Seoul

MEXICO

Representaciones Electronics
de Mexico
Av. Coyoacan 745-16
Mexico, D. F.

NEW ZEALAND

W & K McLean, Ltd.
7 Anzac Avenue
Auckland

NORWAY

P. N. Biorn
Tellbodgt 4
Oslo

PERU

V. M. LaPierre & Cia.
Los Alamos 375
San Isidro, Lima

PHILIPPINES

Radio Electronic Headquarters, Inc.
P.O. Box 1400
Manila

PORTUGAL

Equipamentos de
Laboratoria, Lda.
Apartado 458
Lisbon

SOUTH AFRICA

Leigh & Hurwitz (Pty) Ltd.
P.O. Box 3236
Johannesburg

SWEDEN

Gunnar Petterson
Ostmarksgatan 31
Stockholm-Farsta

SWITZERLAND

Omni Ray AG
Dufourstr 56
Zurich 8

VENEZUELA

Venelectronica
Apartado 10827
Sabena Grande
Caracas

Manufacturers of Microwave & Electronic Equipment